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ELECTRICAL WORLD

April 30, 1932
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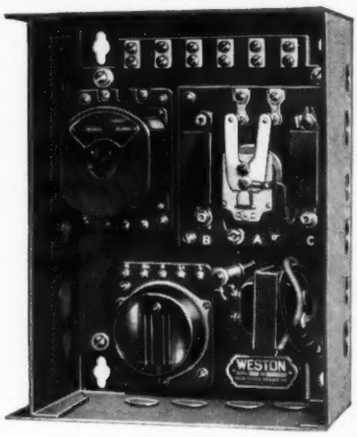

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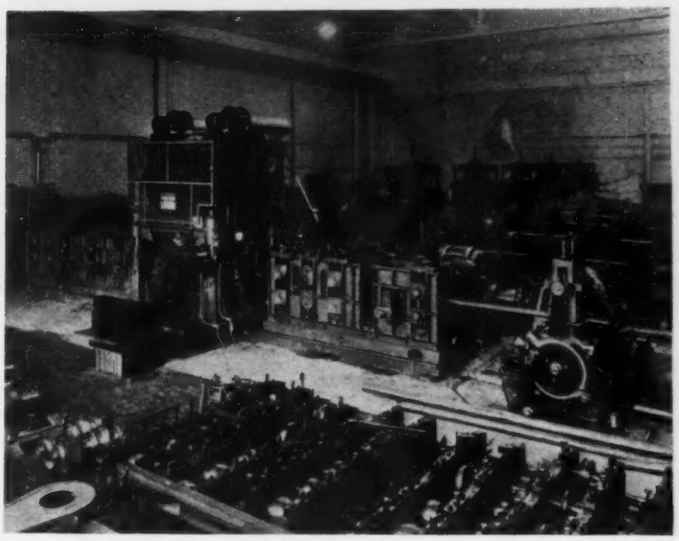

Electric welding of steel tubing Republic Steel Corp.

APRIL 30, 1932

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ELECTRICAL WORLD

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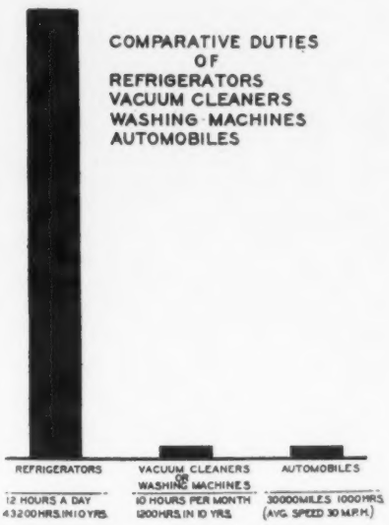

The quiet, trouble-free service of the electric refrigerator is one of the marvels of this mechanized age. As pointed out by W. M. Timmerman, General Electric Company, at the meeting of the Cleveland chapter, A.I.E.E., last week, refrigerator duty is much heavier than that of other familiar devices.

—**Electrometallurgy advances** as this method of direct production succeeds its predecessors. Day of copper smelting is passing, Electrochemical Society hears. New metal costs reduced—*p. 755.*

—**Gruhl succeeds F. L. Dame** as president of the North American Company. Latter becomes chairman of the board, stating: "I am not curtailing my active service and shall continue to serve in full-time capacity"—*p. 789.*

N.E.M.A. opposes all-metal wiring

—**Follow the Electrical Code** is the policy of the National Electrical Manufacturers' Association. Board of directors voices recognition of benefits of contractor sales efforts, but opposes Electragist plan—*p. 761.*

—**Sales and satisfaction clash,** for one is secured by creating dissatisfaction with the *status quo* and the other by maintaining it. Merchandising and good public relations thus a problem of conflicting elements—*p. 786.*

Interconnection service improves

—**Improved plans of operation** enable realization of marked economies in use of capacity and large tie-ins. Frequency control an important factor in securing better performance—*p. 763.*

—**Ingenious wiring expedients** adopted in Philadelphia building. New practices and new tools devised to facilitate construction and assure continuous energy supply throughout—*p. 778.*

Canada will back Beauharnois

—**Bondholders have the power** in present difficulties of the $55,000,000 St. Lawrence project, now 70 per cent completed, to open way for Dominion aid to this development—*p. 756.*

—**Problems of turbine design** should be understood by the user if misunderstandings as to equipment performance and development are to be avoided, C. R. Soderberg maintains—*p. 772.*

North American executives shift

Utility Taxation a Live Issue in Indiana

Opponents of companies attack Tax Commission for assessing property at much less than statutory methods require.

FOES of utility companies in Indiana showed their hand last week when methods of assessing public utilities used by the State Board of Tax Commissioners were attacked by S. C. Kivett, Martinsville attorney. Mr. Kivett took a deposition from the board members in connection with a suit to recover approximately $175,000 in back taxes alleged to be due one township near Indianapolis by the Indiana Electric Corporation. The case has been taken to the circuit court at Danville on a change of venue.

If the suit, which is based on the assessments of the years 1926 to 1931 inclusive, is successful, it will be the forerunner of a whole series of similar suits against all sorts of utilities in all parts of the state. A similar suit already has been filed at Bloomington, as reported in the ELECTRICAL WORLD last week (page 722); another is under investigation at Vincennes, and taxing officials of the smaller governmental units all over the state are beginning to take cognizance of the possibilities.

Philip Zoercher, a member of the state tax board, admitted that in fixing the taxable valuation of the properties the board had not added together the amount of shares of stock and the mortgages, as required by the law, and had not declared that to be the true value of the properties. He said the sworn statement made by the utilities, which included the factors named, represented the book value of its properties, and that the board fixed the assessment at about one-third this sum. Any higher assessment would have given the utilities a return less than 8 per cent and would probably have brought increased rates, he said. Mr. Kivett said the tax board was not concerned with rates. Mr. Zoercher replied: "We knew that such valuations as you suggest would not stand in court." He and the other members of the board protested that they were uninfluenced and actuated solely by a desire to be fair.

More legislation aimed at the control and restriction of utilities is being framed now in the minds of prospective legislators and office holders in Indiana than at any time since the Shively-Spencer regulation law was passed, nearly twenty years ago. Utility executives are expecting a deluge of such legislation next year, and it is admitted that many prospective legislators will fear to assume any attitude savoring of friendliness.

▼

JOSEPH HENRY CENTENARY CELEBRATED

—Wide World Photos

Meeting in annual session at Washington, the National Academy of Sciences seized the opportunity to celebrate the centenary of Joseph Henry's electrical discoveries. Surrounding a magnet made by him in 1831 are (left to right) Dr. Simon Flexner of the Rockefeller Institute, President W. W. Campbell of the University of California and the N. A. S., and Wilder D. Bancroft, professor of physical chemistry at Cornell.

▼

Mississippi, Too, Considers Suing for Unimposed Taxes

A motion has been made in the Mississippi Legislature to appropriate funds to open suits by the state against four utility companies for back taxes. The advocates of the suits charge that the state tax commission undervalued and underassessed the properties of the Mississippi Power Company, Mississippi Power & Light Company, Mississippi Utilities Company and Mississippi Service Company.

▼

Maltbie Wants Utilities to Pay Supervision Cost

Milo R. Maltbie, chairman of the New York Public Service Commission, told a legislative committee investigating the state administration recently that a saving might be effected by assessing the cost of supervising utilities against the companies affected. His fellow commissioners joined with him in the suggestion with the exception of George R. Van Namee.

This plan is in operation successfully in some states, Mr. Maltbie said. Among the items for which the utilities might pay he mentioned the granting of certificates of public convenience and, more especially, the cost of rate hearings. Matters not involving much investigation by the commission, such as the authorization of securities issues, might be paid by the commission, he suggested.

▼

Utility League in Illinois Wants Better Regulation

A report just issued by the Utility Consumers and Investors' League, described as "an association of Illinois citizens which has been formed to study the utilities situation and to take such action as may best protect the interests of both the consumers of and the investors in the public utilities of the state," makes the assertion that "Illinois in its dealings with the public utility companies has been slipping backward" and compares the Illinois Commerce Commission unfavorably with the commissions in ten other states, these being Arizona, California, Kansas, Massachusetts, Nebraska, New York, North Carolina, Oklahoma, Oregon and Wisconsin. It blames the Illinois commission for not instituting rate proceedings on its own initiative, cites many cases of what it considers unduly high charges in the electric and gas fields and says:

> We believe that the facts about the breakdown of regulation in Illinois indicate the necessity for an appreciable reduction in the rates to domestic consumers for gas and electricity and for a far more vigorous policy of investigation and regulation by the Illinois Commerce Commission. We believe also that the facts call for an overhauling of the administrative machinery of the commission and for an improvement in the public utility law of the state. At the same time, we wish to make clear that we believe that the legitimate investments in the utility industry should be safeguarded and given an adequate although not an exorbitant return.

No names of executive officers accompany the league's report, which solicits membership and asks for the formation of branch leagues. The names of thirteen directors, mainly from Chicago and the upper tier of the state, are printed in alphabetical order, and the report is signed by them and sixteen others. Harry R. Booth, Chicago is counsel.

Commission paints different picture

Rates for residential and commercial electric service in twelve representative Illinois cities, including Chicago, have been reduced on an average ap-

proximately 30 per cent since the year 1913, according to figures compiled by the Illinois Commerce Commission and just given out by Chairman G. Gale Gilbert. Virtually all other cities, towns and villages in the state have enjoyed similar reductions during that period, the commission's figures show, the dozen municipalities merely being chosen as representative.

▼

Electrochemical Advances Seen at Baltimore Meeting

Several new processes and inventions were recorded at the meeting of the Electrochemical Society in Baltimore on April 21-23. For example, W. E. Greenawalt suggested that the day of smelting copper ores was passing and that the cost of power was the decisive element in using ores in a direct process of flotation and electrodeposition to eliminate smelting and secondary refining. R. C. Ernst and C. A. Mann showed that alloys of copper, cadmium and zinc could be directly deposited from cyanide baths and hinted at ferrous alloys to be made in the same manner.

Electric furnaces for application in both the ferrous and non-ferrous fields received great attention. It is especially encouraging to find these furnaces making headway in foundry practice. They are now used for making high-quality gray-iron castings and non-corrosive steel castings in addition to greater application for the alloy-steel castings in demand for high-pressure and high-temperature applications. About 57 indirect rocking arc furnaces are in operation to produce 400 to 600 tons per day of cast iron, and 50,000 kw. to 60,000 kw. of arc furnaces are in use in cast-iron applications.

The induction furnace is being applied actively to precious-metal and non-ferrous applications and has gained a prominent place in this field. New alloys and rare metals are found to be in demand. Selenium and tellurium are by-products of plants that find a market of increasing proportions and new information is available on beryllium. Selenium used with rubber increases the resistance to abrasion 50 to 80 per cent and is in demand for tires and wire insulation. It is now on the American market to be used with copper for alloys. The price ranges from $8 to $30 per pound at present, depending upon purity and quantity. When 2 to 3 per cent beryllium is added to copper the hardness is increased five times, the limit of ductility seven times and the breaking and bending limits three times. A copper alloy with 7 per cent beryllium has a hardness corresponding to that of the hardest steel, about 750 Brinnell. Springs and valve seats are the chief uses for these bronzes.

Dr. John A. Mathews discussed the new developments in steel and pointed out the unknown factors yet facing students of alloy-steel metallurgy. About 300 were in attendance and the technical program was supplemented with inspection trips to industrial plants in the vicinity of Baltimore. R. A. Witherspoon of the Shawinigan Water & Power Company, Montreal, was elected president.

▼

Westchester 132-Kv. Lines Need Not Go Underground

Vigorous efforts made by property owners in Westchester County, N. Y., to force the Westchester Lighting Company to put underground the 132-kv. transmission line from Dunwoodie, Yonkers, to Millwood, on the Putnam County border, which is to form part of the new Niagara-Hudson-New York Edison interconnection, met with a setback on Wednesday of this week, when the New York Public Service Commission announced its decision. The commission decided that public interest does not require the line to go underground at this time. It said:

> There may come a time when the entire line will be placed underground. It may be that certain portions should be placed underground at present or in the near future, but there has been no proof regarding specific parts, except that we have been asked to direct that the line from Millwood north should be placed underground if we do not order the entire line underground. This section is through a sparsely populated area, and if any section were to be selected for underground construction, there are other parts where underground construction could more reasonably be required.

There is already a transmission line over the route, which is on a private right-of-way. The New York Edison system desires to replace it by one with 82-ft. steel towers about 620 ft. apart.

▼

Northwestern Engineers Make Valuable Studies

Studies of operating problems made with a view to economy dominated the ninth annual general meeting of the Engineering Section of the Northwest Electric Light and Power Association at Portland, Ore., this month.

Operating experience with frequency and load-control equipment on the system of the Washington Water Power Company was portrayed by J. S. McNair. J. C. Henkle, Portland General Electric Company, presented a study of the comparative cost of rebuilding old transformers and replacing them with new. An analysis of factors contributing to losses in distribution systems by P. P. Ashworth, Utah Power & Light Company, precipitated a discussion indicating that a study of losses in each unit of the systems from the generating station to the customer's meter would disclose methods of operating stations and lines at maximum efficiency. A new method of measuring vibration of overhead conductors by the use of an oscillograph was explained by C. O. Crane, Idaho Power Company. A progress report on the radio interference research being conducted at Oregon State College was made by Prof. F. O. McMillan of that institution.

Necessity for lower distribution investment coupled with a growing demand for removal of overhead lines led to a study by T. W. Swartz, Northwestern Electric Company, of the possibilities of a low-cost underground system. This study suggested a design for residential areas costing about 180 per cent of the cost of overhead. Another problem of growing importance, that of Diesel electric generating stations, was dealt with by A. H. Greisser, Portland General Electric Company.

Accountants meet at Spokane

The accountant's responsibility in rate making, the relative merits from an accounting standpoint of joint or individual ownership of jointly used poles, and a thorough analysis of factors contributing to efficiency and economy in operating small branch-office unattended storerooms, were important subjects discussed at the annual meeting of the Accounting Section of the association at Spokane, which followed the Engineering Section meeting.

Business Conditions Little Changed

LISTLESSLY drifting along the way, industrial America showed neither advances nor declines of note.

Energy production for the week was 12.3 per cent below the same period in 1931, as compared with 9.8 per cent previously reported.

Car loadings rose 4 per cent as compared with the previous week, a new high for the year, but were 25.5 per cent below 1931 and 36.5 per cent under 1930.

United States Steel with $13,000,000 deficit for first quarter omits common dividend. Steel-mill activity at 23 per cent.

Business failures 603, against 576 in previous week.

Washington seekers of evildoers in Wall Street horrified by disclosures of artificially created demands for stocks, but remain unperturbed as Federal Reserve purchases boost government bond values to force market participation.

Canadian Government's Plans for Helping Beauharnois

Premier Bennett announced last week in the Canadian House of Commons that the Dominion government is prepared to do its part in insuring that the Beauharnois power project, as a construction enterprise, shall be carried to completion. The government's efforts, however, are contingent upon co-operation from the banks interested, the government of Quebec and the bondholders. According to Mr. Bennett the power project has to date cost $39,000,000 and will probably have cost $55,000,000 when completed. Construction work is up to schedule and within the estimate of cost, and it can be completed by October 1 of this year, in time to fulfill power contracts made, if financial requirements can be met. To make this possible the government has secured the banks against loss on advances made thus far, totaling $7,951,500, and will give sympathetic consideration to the acquisition by the second-mortgage holders of the first-mortgage securities issued to finance the enterprise.

Premier Bennett's announcement virtually means that the Beauharnois Corporation's future lies in the hands of the second-mortgage collateral trust bondholders, the so-called debenture holders, whose interest is in the thirty-million dollar, 30-year issue of the Beauharnois Power Corporation, secured by the outstanding capital stock of sundry subsidiaries. The corporation is in default of interest on these debentures as from April 1, but, as explained by Premier Bennett, the holders may yet exercise the authority vested in them under the trust deed or take such other action as they may see fit and are competent to take. They can, according to the Premier, become owners of every share of stock in the parent enterprise, the Beauharnois Light, Heat & Power, Limited, subject to the first-mortgage bonds.

Severe reproof of three Canadian Senators, Andrew Haydon, W. L. McDougald and Donat Raymond, is contained in the majority report of the Senate committee which investigated their connection with the Beauharnois project. Senator McDougald's actions are declared to have been "not fitting or consistent with his duties and standing as a senator"; the acceptance by Senator Haydon of $50,000 and a retainer from the corporation is strongly condemned, and fault is found with Senator Raymond for accepting campaign funds from a company dependent on government franchises or concessions.

▼

Wider Investigation for Beauharnois in Ontario

After months of discussion and urging on the part of various political bodies and individuals, the payment of $125,000 to John Aird, Jr., of Toronto, by the Beauharnois Power Corporation is being investigated by a one-man commission in the person of Justice J. F. Orde of Toronto. The new procedure followed suspension several weeks ago of an inquiry into two hydro matters when Justice W. E. Middleton, acting as a royal commission, became ill (ELECTRICAL WORLD, March 12).

The announcement, issued by the Attorney General of Ontario, added that Justice Middleton had resigned his commission and had recommended that the scope of the inquiry, which previously dealt only with purchases of power rights by the Ontario Hydro-Electric Power Commission on the Madawaska River and the purchase of the Dominion Power & Transportation Company of Hamilton, be widened to include the payment by the Beauharnois Power Corporation to Mr. Aird.

The inquiry opened last week and, after taking testimony, was adjourned to May 9. G. H. Ferguson, former Premier of Ontario, denied that any part of the Beauharnois payment to Mr. Aird reached the Conservative party. Not much light on Aird's activities as middleman in either the Madawaska or the Beauharnois transaction was shed. Letters were read that had been written by J. G. G. Kerry, consulting engineer with M. J. O'Brien, Limited, the power rights of which on the Madawaska River were purchased by the Hydro-Electric Power Commission. In one of these letters Mr. Kerry said that, though the Conservative party was inclined to hold to the policy of Sir Adam Beck and oppose private development of water power, Premier Ferguson and C. A. Magrath, chairman of the Hydro commission, were not at that time against private development. J. A. O'Brien, vice-president of the O'Brien firm, testified that the Madawaska negotiations opened with the naming of a price of $2,500,000, but that this was cut to $1,800,000, the commission undertaking to compensate Mr. Aird.

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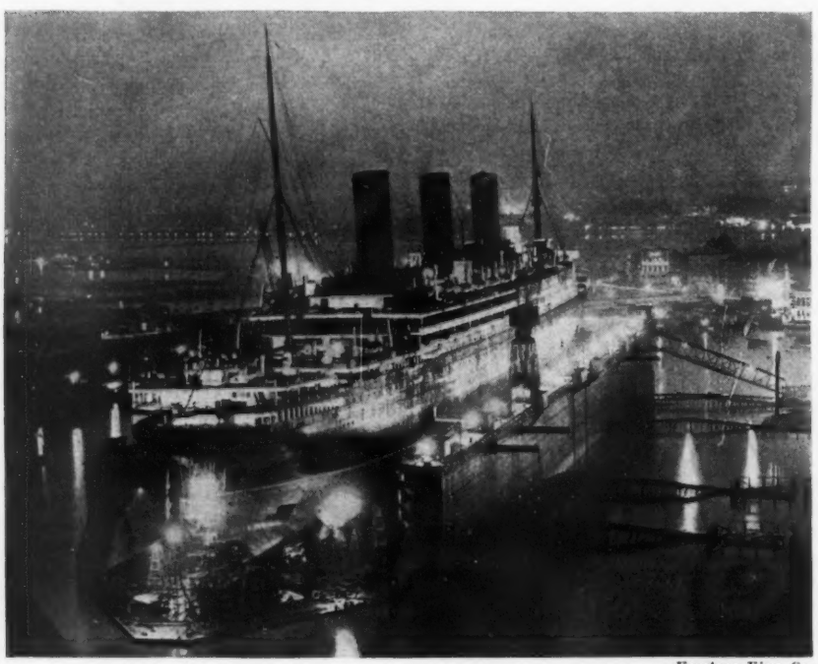
ARC LIGHTS SPEED UP TRANSATLANTIC TIMETABLE



—Keystone View Co.

By night as well as by day top speed is the rule at the floating dock of Southampton, England, when repairs must precede scheduled sailings. Here is the Cunarder *Berengaria* being overhauled.

▼

Providence Program of A.I.E.E. Promises Well

Next in order in A.I.E.E. district gatherings is the eighth annual meeting of the Northeastern District, to be held in Providence on May 4 to 7. Technical session proceedings are to include a symposium on traffic control and sessions on electrical machinery and power transmission, besides another devoted to selected subjects.

Other features will be the student technical session, the banquet on Thursday evening, with Prof. W. H. Kennerson of Brown University as toastmaster and Past-President W. S. Lee, President C. E. Skinner and Vice-President I. E. Moultrop as speakers; social gatherings, and inspection and sight-seeing trips.

Seattle Council Pushes Diablo Dam Completion

Construction of a power house at Diablo Dam, erection of the two 67,500-kva. hydro generating units already purchased, construction of a transmission line between the Diablo and Gorge Creek stations and completion of other work in the Skagit development is provided for in a bill passed last week by the Seattle City Council and approved by the Mayor. The city comptroller will offer light and power bonds for $3,500,000 to cover the cost of this work and to pay the outstanding warrants issued for Skagit improvements. May 18 has been fixed for the opening of bids for the bonds, and at the same time the Board of Public Works will receive bids for the extension work, payment to be made in bonds or cash. If the bonds bring a reasonable offer, they will be sold outright. If satisfactory bids for the bonds are not received, the low bid for the contract to complete the Diablo work will be accepted. The successful bidder must not only accept bonds in payment for his work, but he must take additional bonds in amount sufficient to pay the $1,400,000 present indebtedness on the plant. Efforts will be made to bring out offers to rival the recent proposal of the Bayly Hipkins Company (ELECTRICAL WORLD, February 20, page 341).

▼

Utility Fights Proposed Birmingham Rate Cuts

Net earnings of the Birmingham Electric Company would drop to 3.34 per cent during the next twelve months if the rates proposed by the Alabama Public Service Commission were put into effect, J. S. Pevear, president and general manager of the company, said at a rate hearing held in Birmingham recently. Present earnings of the company were given as 5.11 per cent. The hearing is being held by the commission following a recommendation by its chief engineer, I. F. McDonell, for a revised rate schedule which includes a minimum contract basis of $2 for a house of four rooms or less against the present contract rate of $3 a month for a six-room house or less. The engineer also recommended certain reductions for small commercial users. By his figures the company earned 14.6 per cent last year exclusive of its trolley and steam-heating services.

The electric company opposes separation of the street-railway unit for rate-making purposes. There is no way, Mr. Pevear stated, for the street railway to earn a fair profit as a separate entity, even if fares are increased from 7 to 10 cents. Mr. Pevear filed a proposed new schedule calling for $1.11 a month for the first 10 kw.-hr., 8.5 cents a kilowatt-hour for the next 90, 11 cents for the next 125, 6 cents for the next 150, 5 cents for the next 2,000 and 4 cents for all additional.

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P. G. & E. Rate Hearings Adjourned Until June

After a brief session on April 20 the California Railroad Commission continued until June 1 its investigation of electric rates charged by the Pacific Gas & Electric Company in San Francisco and other Bay cities. The continuation was granted at the request of Dion Holm, attorney representing San Francisco, who stated that additional data are necessary and would take several weeks to compile. Among others who have joined with the San Francisco Bay communities in an effort to secure reduction in rates are a number of electric railways in northern California, the California Farm Bureau, the Building Owners and Managers' Association of San Francisco, the Dry Goods Association and the East Contra Costa Irrigation District.

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Northwestern Electric Rate Hearing Begins

Adjustment of the book value of the property of the Northwestern Electric Company, Portland, Ore., to a figure below that claimed by the company and an attack on the financial structure of the company and on the management contract with the Electric Bond & Share Company in so far as its relation to rate making is concerned were features of the first week's hearing before the Public Service Commissioner of Oregon on the company's valuation and rates. In this first phase of the case, commencing April 11 on the Commissioner's own motion and concluding April 16, only the direct examination of the Commissioner's witnesses was heard. A recess for two weeks was then taken to give the company time to digest the testimony.

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Atlanta's Mayor Vetoes Appeal for Rate Cuts

Efforts to reduce the rates on electric power and natural gas in Atlanta are receiving slight sympathy from Mayor James L. Key, who has now vetoed a resolution passed by the City Council asking the legal department of the city to petition the Georgia Public Service Commission for such reductions. "Twice during the last year," says Mayor Key, "the matter or rates for public utilities has come before the Georgia Public Service Commission. In both cases the contention of the city was dismissed. It would be of no advantage to the city at this time to take up this matter again without additional facts or arguments for lowered rates," One of the cases referred to by the Mayor concerned the Georgia Power Company; the other involved gas rates.

Coming Meetings

National Electric Light Association—Engineering Section committee meetings, Hotel Pfister, Milwaukee, May 1-4. A. J. Marshall, 420 Lexington Ave., New York.

American Institute of Electrical Engineers—District meeting, Providence, May 4-7; summer convention, Cleveland, June 20-24. Acting secretary, 33 West 39th St., New York.

National Electrical Manufacturers' Association—Hot Springs, Va., May 15-20. A. W. Berresford, 420 Lexington Ave., New York.

Middle West Division, N.E.L.A.—Muehlebach Hotel, Kansas City, Mo., May 18-20. Thorne Browne, 1527 Sharp Bldg., Lincoln, Neb.

East Central Division, N.E.L.A.—Commodore Perry Hotel, Toledo, Ohio, May 24-27. D. L. Gaskill, 603 Broadway, Greenville, Ohio.

National Electric Light Association—Atlantic City, N. J., June 6-10. A. J. Marshall, 420 Lexington Ave., New York.

Pacific Coast Electrical Association—Hotel Huntington, Pasadena, Calif. June 14-17. K. I. Dazey, 447 Sutter St., San Francisco.

Canadian Electrical Association—Manor Richelieu, Murray Bay, Que., June 15-17. B. C. Fairchild, 409 Power Bldg., Montreal.

Public Utilities Advertising Association—Waldorf Astoria, New York, week June 19. J. R. Pershall, Public Service Co. of Northern Illinois, Chicago.

American Society for Testing Materials—Chalfonte-Haddon, Atlantic City, June 20-24. C. L. Warwick, 1315 Spruce St., Philadelphia.

American Society of Mechanical Engineers—Bigwin Inn, Lake of Bays, Ontario, June 27-July 1. C. W. Rice, 29 W. 39th St., New York.

New England Division, N.E.L.A.—Mount Washington Hotel, Bretton Woods, N. H., July 11-13. Miss O. A. Bursiel, 20 Providence St., Boston.

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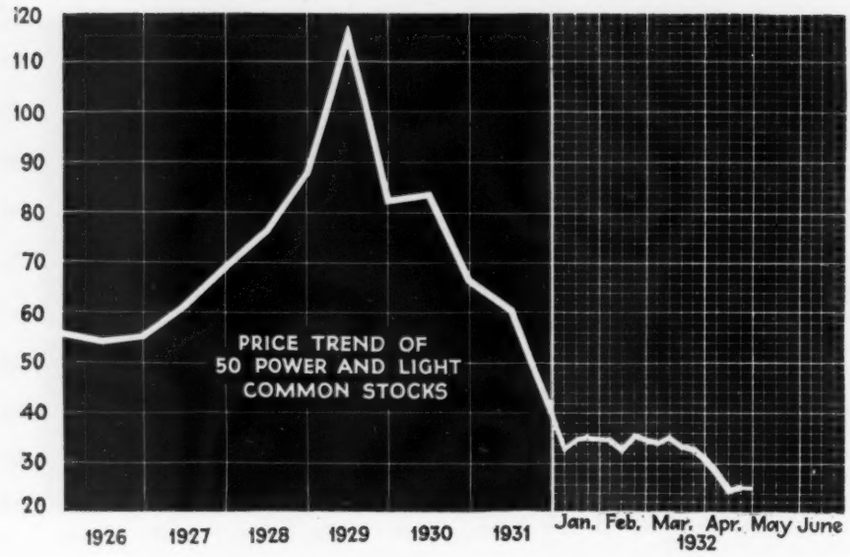
Southern Colorado Cuts Domestic Energy Rates

The Southern Colorado Power Company, with headquarters in Pueblo, has announced rate cuts to domestic customers varying from 0.5 cent to 1 cent per kilowatt-hour, effective May 21. In addition to Pueblo and Canon City, the company serves many smaller communities in agricultural and mining areas.

About half the annual estimated savings of $75,000 to customers will fall to Pueblo under the new schedule, which provides a reduction from 9 cents to 8 cents. The average rate in other Southern Colorado Power Company territory is now 10.8 cents and will be a flat 10 cents. Cripple Creek and Victor, mining towns where 11.7-cent rates have prevailed, will be put on an 11-cent basis. Westcliffe will have its rate lowered from 13.5 to 13 cents.

Utility Stocks Hold Ground



Slight improvement appeared in the stock market during the week, but trading was rather dull. Electric light and power prices fluctuated within a narrow range, small gains in some issues being offset by similar losses in others. The "Electrical World" average of 50 representative stocks was 25.8, as compared with 25.3 for the preceding week.

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Philadelphia Electric Report Reflects Stability

In spite of the adverse situation the annual report of the Philadelphia Electric Company reflects the stability of that utility's financial structure. System operating revenues (electric, gas and steam heat) were $65,669,649, an increase of $366,310, or 0.6 per cent, over 1930. Electric operating revenue decreased 0.7 per cent, being adversely affected both by the recession in business activity and by a full year's experience of the substantial reduction in electric rates effective September 1, 1930.

Customers connected to the lines of the company totaled 765,272 as of December 31, 1931, a net gain of 6,045 customers, or 0.8 per cent, over the number connected as of December 31, 1930. Electric customers at the end of the year numbered 636,451, an increase of 5,469, or 0.9 per cent. System sales of electricity, amounting to 2,673,087,042 kw.-hr., were under those for the preceding year by 2.2 per cent, but eliminating the effect of sales to other electric utilities for resale, kilowatt-hours sold to ultimate consumers in the company's territory were only 0.4 per cent less than in 1930. When the unsettled condition of general business is considered, this is a good operating record.

Dividend payments, together with certain expense in connection with unamortized debt discount and premiums in connection with retirement of bonds, totaled $23,964,165, while net income available for dividends and surplus amounted to only $21,978,224. This accounts for the drop in unappropriated surplus from $15,857,623 at the end of 1930 to $13,899,364 at the end of 1931.

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Energy Production Abroad Rises Despite Conditions

Transfer of energy across international frontiers in Europe runs into large figures, despite the present tendency of countries to make themselves as nearly self-contained as possible. The latest figures available show that Switzerland exported about 1,000,000,000 kw.-hr. in both 1929 and 1930. France imported 621,000,000 kw.-hr. and exported 135,000,000 kw.-hr. in the former year and 10 per cent more in 1930. Italy, Czechoslovakia, Poland, Sweden and Denmark each get a certain amount from outside sources, the last named nearly 20 per cent. These figures have just been published by the International Union of Producers and Distributors of Electrical Energy. German statistics on this point are not included, but that country, too, is known to have an appreciable movement of energy in both directions across its borders.

The increased production of certain countries in 1930 over 1929 is noteworthy, in view of the world-wide economic disturbance. The report is incomplete as to several important countries, in particular Germany and Great Britain, but among those listed there is an increase, stated in millions of kilowatt-hours—in France from 14,319 to 15,600, in Italy from 10,557 to 10,836, in Belgium from 1,768 to 1,985, in Switzerland from 3,509 to 3,583, in Soviet Russia from 3,542 to 5,093. The last figure merits attention, since the increase is equivalent to 44 per cent.

Finland is not commonly thought of as a country of importance industrially or one highly electrified. However, her energy output in 1930—1,186,000,000 kw.-hr.—was equal to 60 per cent of Belgium's, though her population, about 3,600,000, is only 45 per cent as large. Of the amount left after deducting losses a remarkably large part is used industrially, and only 9 per cent goes into domestic, commercial and public services.

Outside of Europe, Japan produced 13,957,000,000 kw.-hr. in 1930 and South Africa 956,000,000 kw.-hr. Comparison with the United States is afforded by the 88,492,000,000 kw.-hr. credited to this country for the same year.

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Middle West Subsidiaries to Protect Assets

Most recent developments in the failure of the Middle West Utilities Company point to the conservation of the assets of subsidiary companies, even though Middle West readjustment difficulties are thereby intensified. The situation in regard to the Insull investment companies has undergone no notable change since last week.

Receivers have been appointed for United Public Service Company, an intermediary holding company of the Middle West group, by Vice-Chancellor John J. Fallon in Jersey City, N. J. Following the refusal of Federal Judge Clark of New Jersey to appoint receivers for Southern United Gas, Southern United Ice and United Public Utilities, the receivers for United Public Service applied for such action.

Orders to recover $5,000,000 in assets alleged to have been transferred from United Public Service to Middle West have been issued by Vice-Chancellor Fallon to the receivers of the former. A protective committee for the holders of $40,000,000 Middle West 5 per cent serial gold notes has been formed.

Earnings of 45 utility operating companies under Insull management are shown in a résumé made by Halsey Stuart & Company to be well sustained as of the close of 1931.

Lilienthal on Safeguarding Wisconsin Subsidiaries

Having in mind the Wisconsin Power & Light Company of Madison and the Lake Superior District Power Company of Ashland, Wisconsin operating subsidiaries of the Middle West system, David E. Lilienthal, member of the Wisconsin Public Service Commission, said recently:

This commission, to the full extent of its power, will, in my judgment, not permit the receiver of the defunct Middle West Company to drain off assets of subsidiary public utilities operating in this state for the benefit of the insolvent holding company, whether by way of intercompany borrowings, through the declaration of dividends to the receiver or by the slighting of depreciation reserves. Our duty is to Wisconsin consumers and the investors in the securities of these Wisconsin utilities, and we intend to let nothing stand in the way of this objective. . . .

Steps in this direction had already been taken by the commission prior to the announcement of the receivership. . . . As a result there is now virtually nothing due the Wisconsin Power & Light Company from the Middle West company or from its immediate parent, the Northwest Utilities Company. Neither does the Wisconsin Power & Light Company owe the Middle West Utilities Company or the Northwest Utilities any substantial sums.

This commission has given continuous consideration to conserving the property of the local company in two other ways—first, through insisting upon the company's strengthening the depreciation reserves; . . . second, by preventing the payment of dividends on the common stock to the holding company at a time when it is sound business to conserve the cash position of the company. In addition, the commission, I am confident, will not permit the payment of dividends on the common stock to be made to the receivers under present conditions but will insist that the money that might possibly go to such payments be used to build up depreciation and other reserves. . . . There have been no payments of dividends during 1932 by the Wisconsin Power & Light Company, and I am certain that the commission will not permit such payments now.

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Central Power & Light Is Untouched by Receivership

Receivership of the Middle West Utilities Company will not affect the Central Power & Light Company, according to E. B. Neiswanger, president of the latter. "This receivership," Mr. Neiswanger said, "will not involve any slowing down in the activities of the Central Power & Light Company in the 186 cities and towns of south and southwest Texas served by it. The Central Power & Light is strictly an operating company and its properties are in excellent physical condition. Its business, in view of the economic conditions, is on the whole satisfactory and its ability to finance itself is not impaired. All of its operations will continue as usual."

But not Central Texas Hydro

All construction work on the four-million-dollar dam and 35,000-hp. hydro-electric project of the Central Texas Hydro-Electric Company on the Colorado River about 50 miles above Austin has been suspended for an indefinite period, according to F. A. Dale of Austin, manager of the company. More than $1,500,000 has already been expended, the work having been in progress eleven months. The receivership of the Middle West Utilities Company is given as the cause of the indefinite temporary shutdown. Mr. Dale said the company has been unable to get money with which to further carry on the construction operations. The contract for building the dam is held by the Fegler Construction Company. It had approximately 450 men employed at the time work was suspended.

This dam and hydro-electric plant were to have been one of five that the company was authorized by the State Board of Water Engineers to construct at points on the Colorado River above Austin at a total cost of $25,000,000. The prospective electric power was to have been taken by Insull subsidiaries in Texas.

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Kentucky Utilities Says It Is In Good Condition

L. B. Herrington, president Kentucky Utilities Company, Louisville, subsidiary of the Middle West Utilities Company, has made public a statement holding that his company will in no way be affected by or involved in the financial difficulties of the parent organization. He said in part:

"Rumors, misinformation and speculation have been voiced about the financial condition of the Kentucky Utilities Company. In spite of present economic conditions, the business and earnings of Kentucky Utilities Company are satisfactory. Our situation at the end of the first quarter of 1932 is appreciably stronger than it was at the same time in 1931."

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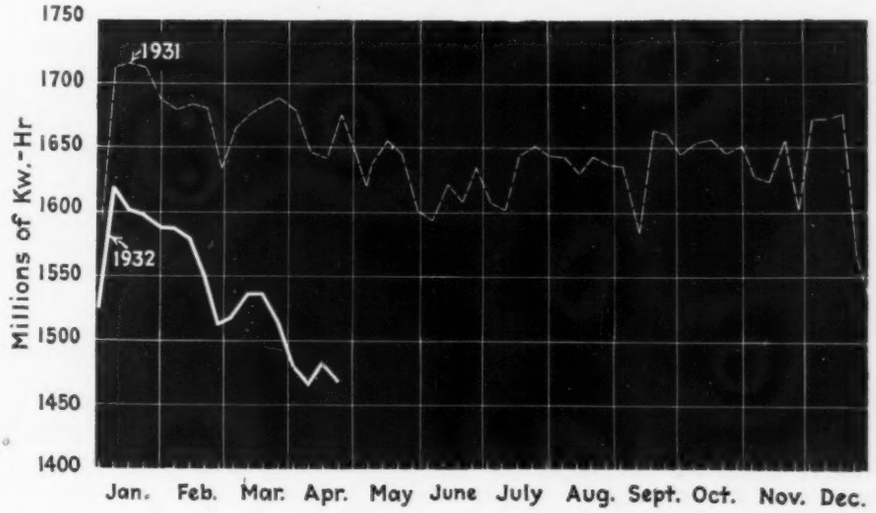
Minor Fluctuations in Output



WHILE the energy output for the week ended April 23 decreased by a fraction of a per cent compared with the preceding week it was higher, by a very little margin, than in the week of April 9. Practically speaking, the output has changed but negligibly during the past four weeks. The slight fluctuations may easily be due to the weather or almost any other temporary condition.

Nor should the fact that, compared with last year, the output is down 12.3 per cent while it was down only 9.8 per cent a week ago be taken too seriously. Most of the difference is due to an erratic peak in 1931, as is evident from the chart.

This peak needs to be considered also in connection with the regional averages, which are all down relatively to 1931 by a greater percentage than the week before, save on the Pacific Coast.

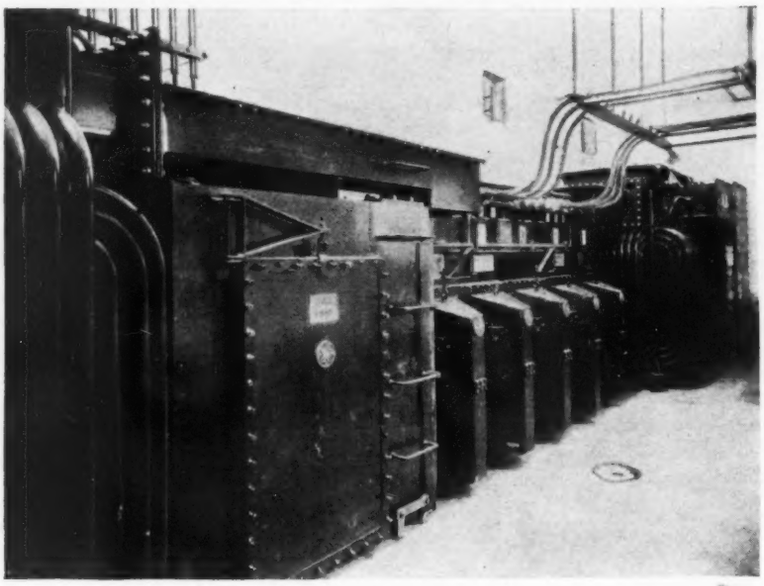
Weekly Output, Millions of Kw.-Hr.

	1932	1931	1930	1929
April 23	1,470	1,676	1,725	1,700
April 16	1,481	1,641	1,733	1,709
April 9	1,465	1,647	1,715	1,697
April 2	1,480	1,680	1,708	1,663
March 26	1,515	1,689	1,723	1,680

Per Cent Change from 1931

Region	Week Ended April 23	April 16	April 9
Atlantic Seaboard	— 8.9	— 3.0	— 5.6
New England alone	— 9.4	— 5.3	— 8.5
Central industrial	—17.3	—13.5	—14.8
Chicago district	—14.8	— 9.7	— 8.8
Pacific Coast	—11.8	—12.9	—13.8
United States	—12.3	— 9.8	—11.1

DOUBLE UNIT HELPS REFRIGERATE BAY STATE FISH



A pioneer duplex network unit has been installed by the Boston Edison company to serve Fish Pier on Boston Harbor and an adjacent neighborhood. Two 1,500-kva. G. E. transformers and the necessary relay cabinets and circuit breakers take the place of the customary single transformer and accessories to provide abundant service for one of the largest receiving depots of the kind in the world. As the load picks up one transformer can readily be shifted to another installation point.

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Philadelphia Company's Earnings Off 8.91 per Cent

The annual report of the Philadelphia Company and subsidiary companies for the year ended December 31, 1931, shows consolidated gross earnings totaling $56,036,779, a decrease of $5,484,265, or 8.91 per cent, and net earnings, including other income, before appropriations for retirement (depreciation) reserves, were $29,670,360, a decrease of $1,799,019, or 5.72 per cent. The balance available for dividends after appropriations for retirement (depreciation) reserves, amortization and other reserve funds was $14,278,285 for the year 1931, compared with $15,330,103 for 1930, a decrease of $1,051,818.

Earnings of the company and its subsidiaries, it is stated, were adversely affected by the depressed state of business in the Pittsburgh district.

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Tri-Utilities Assets to Be Auctioned

Public auction of a large portion of the remaining assets of the Tri-Utilities Corporation will be made on May 9, when seven parcels of securities of that corporation, now in receivership, are offered to the highest bidder by the Equitable Trust Company of New York, as successor-trustee.

The securities consist principally of notes and of the collateral, in cases where the notes are secured, underlying the obligations. The sale will virtually remove the American Natural Gas group of properties from the Tri-Utilities System, similar to the separation of the Federal Water Service Company, recently completed.

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American Light & Traction Defends Management

Denial of the principal allegations in the suit begun last year by Harry Helfman, holder of 5,700 shares of common, and Stockton Cranmer, holder of ten shares, has been filed in the Chancery Court of New Jersey by the American Light & Traction Company, one of the defendants. The complainants alleged that certain sales of securities by American Light & Traction in 1928 had resulted in a loss of more than $25,000,000 to the company and its stockholders.

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Associated Gas Reduces Capital

Notice of the reduction in capital from $237,017,463 to $175,000,000 has been filed with the Secretary of State of New York by the Associated Gas & Electric Company. The entire amount of the reduction, $62,017,463, has been carried to surplus, inasmuch as none of the assets has been written down.

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Record Stockholders for Consolidated Gas of Baltimore

Consolidated Gas, Electric Light & Power Company of Baltimore had 18,785 stockholders on its books as of March 1, 1932, a new high record. Of the total, 10,320 held common and 8,465 preferred shares, comparing with 10,137 common and 8,222 preferred stock holders on January 1, 1931.

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Current Earnings Reports of Electric Light and Power Companies

OPERATING COMPANIES

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
Louisville Gas & Electric (Year ended January 31)					
Gross earnings	$10,507,420	$10,625,758	— 1.1	45	48
Net earnings	5,743,850	5,513,923	4.2	..	..
Northern States Power (Year ended January 31)					
Gross earnings	33,937,108	33,305,891	1.9	48	50
Net earnings	17,592,026	16,653,902	5.6	..	..
Oklahoma Gas & Electric (Year ended January 31)					
Gross earnings	11,837,642	14,001,685	—15.4	49	53
Net earnings	6,017,730	6,542,318	— 8.1	..	..
San Diego Consolidated Gas & Electric (Year ended January 31)					
Gross earnings	7,535,009	7,439,252	1.3	49	49
Net earnings	3,870,678	3,768,089	2.7	..	..
Wisconsin Public Service (Year ended January 31)					
Gross earnings	5,485,067	5,580,665	— 1.7	56	59
Net earnings	2,406,435	2,306,474	4.3	..	..

HOLDING COMPANIES

	1932	1931	Per Cent Increase	Operating Ratio 1932	Operating Ratio 1931
American Power & Light & subs. (Year ended February 29)					
Gross earnings	$82,073,668	$86,369,770	— 5.0	47	48
Net earnings	43,349,154	44,922,144	— 3.5	..	..
American Water Works & Electric & subs. (Year ended February 29)					
Gross earnings	49,025,129	53,450,018	— 8.3	50	51
Net earnings	24,458,046	25,861,812	— 5.4	..	..
National Power & Light & subs. (Year ended February 29)					
Gross earnings	76,622,828	79,626,476	— 3.8	52	55
Net earnings	36,345,612	36,023,698	0.9	..	..
Philadelphia Company (Year ended January 31)					
Gross earnings	54,991,415	61,289,974	—10.2	50	51
Net earnings	27,383,071	30,082,508	— 9.0	..	..
Standard Gas & Electric & subs. (Year ended January 31)					
Gross earnings	144,023,060	153,257,280	— 6.0	50	52
Net earnings	71,364,764	73,534,397	— 2.7	..	..

Associated Gas Earns 84 Cents on Class A Stock

For the year ended December 31 operations of the Associated Gas & Electric Company resulted in a balance of revenues available for the class A common stock amounting to $3,812,939, or 84 cents a share, on the 4,518,498 average number of such shares outstanding. This compares with $2.30 a share on 5,675,782 class A shares outstanding during 1930.

Total operating revenues for 1931 were $90,516,980, as compared with $90,106,778 for 1930. Total operating expenses and taxes aggregated $47,470,799, against $47,489,414, leaving net operating revenues amounting to $43,046,181, against $42,617,364. After $8,308,412 for depreciation, operating income totaled $34,737,768, against $36,918,856. After fixed charges and interest on junior obligations, convertible into stock at the option of the company, net income applicable to preferred and common issues totaled $7,973,030. Total assets of the company as of December 31 were $691,115,960, against $593,396,275.

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Allis-Chalmers Net Loss $936,395 for First Quarter

The Allis-Chalmers Manufacturing Company's report for the first quarter of 1932 shows a net loss, after all charges, including interest on debentures and depreciation, of $936,395, compared with a net profit of $482,808 for the corresponding quarter a year ago. Billings in the current quarter were $3,593,966, as against $7,936,630 in 1931.

Bookings for the three months of 1932 amounted to $2,984,377, contrasted with $6,450,788 in the 1931 period. Unfilled orders March 31, 1932, aggregated $7,279,745 and $7,889,334 at the close of 1931.

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Flexible Cord Makers Expand Betterment Plan

Substantially all the manufacturers of flexible cord have now enlisted in the program for insuring safer and better extension cords. According to a recent announcement by the National Electrical Manufacturers' Association 28 companies are now co-operating in the movement, which started last June with twelve companies enlisted. Essentially, the movement involves the adoption of a small bracelet-like Underwriters' Laboratories label applied to approved types of flexible cord at intervals of five feet.

During the past few weeks this group of N.E.M.A. has taken the second step in its original program by mailing attractive, well-designed, double-page letters explaining the extent and character of its work to about twelve thousand retail outlets.

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N.E.M.A. May Adopt Modified Swope Plan

One of the most important subjects for discussion at the May meeting of the National Electrical Manufacturers' Association, to be held in Hot Springs, Va., May 16-20, will be the proposed N.E.M.A. mutual unemployment benefit plan. This recommendation has been submitted to the executive committee of N.E.M.A. and is based upon a study of the original Swope plan. The executive committee has approved the plan and instructed that it be submitted to the Policies Division with recommendations for approval.

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N.E.M.A. Backs the Code; Opposes All-Metal Wiring

While recognizing the benefit which would in all probability accrue to the entire industry through the enlistment in intelligent sales effort of the large body of contractors and their employees and recommending the effort toward such enlistment, the board of governors of the National Electrical Manufacturers' Association has disapproved the recently announced all-metal-wiring plan of the Association of Electragists International for the four reasons which follow here:

(a) The program embodying "all-metal wiring" as its declared object conflicts with fundamental N.E.M.A. policy. N.E.M.A. accepts and indorses in its entirety the National Electrical Code, as approved by the American Standards Association, as its standard in the matters treated. This code is formulated by procedure evolved through years of consideration of the problems involved and represents the best consensus of industry opinion in regard to them.

(b) N.E.M.A. fundamental policy is directed to establishment throughout the country of the National Electrical Code, as the basis for local ordinances. It holds that any ordinance which has for its purpose the restriction of wiring to any specified type or types is not in the best interests of the public or of the electrical industry, and if generally adopted would retard progress in the acceptance of new material and methods developed in the interest of cost reduction and admitted to the code.

(c) The intensive development of a body of local industry code and wiring standards committees, intimately concerned only with a single local aspect of the general situation and active in the promotion of local legislation without knowledge or consideration of what may be its ultimate effect upon the national situation, is contrary to N.E.M.A. policy and practice. Experience has shown that in time, long or short, such bodies inevitably are used, even without their own realization, for purposes foreign to that for which they were constituted and frequently by those possessed of an ulterior motive.

(d) The ordinance proposed by the Association of Electragists International conflicts with N.E.M.A. policy in providing that the approval of the local jurisdiction shall be obtained before offering for sale any electrical material, device or appliance. N.E.M.A. is unconvinced of the wisdom of this procedure.

Major New Construction This Week

FUND of $265,000 will be used by Potomac Edison Company, Hagerstown, Md., for transmission and distributing line replacements and reconstruction, including poles, wire and cable, line fittings, transformers and accessory equipment.

Three Diesel engine-generating units are asked for in bids closing May 12 by Oregon State Board of Control, Salem, Ore., with accessory equipment for a $150,000 power plant for service at state institutions. Poles and pole-line equipment and fittings, wire and cable and meters also needed.

Motors and controls, panelboards and instruments, conveying equipment, etc. needed for proposed $55,000 mill addition, Rowan Cotton Mills Company, Salisbury, N. C.

Bids on $225,000 expansion programs for city-owned power station at Springfield, Ill., will soon be called. Contract awarded General Electric Company for 10,000-kw. turbo-generator unit at $156,500.

Until May 16 bids asked for a city-owned light and power plant at Lenox, Iowa, including two Diesel engine-generating units, exciters, pumps, switchboards, instruments, transformers, wire and cable. A $100,000 project.

Complete electrical equipment for lock operation on Des Plaines River, near Joliet, Ill., to be bid in before May 18, through United States Engineer office, Chicago, Ill., including electric power control and indicating equipment, signals, illuminating equipment, electric cable and complete accessories.

Power substation equipment to cost over $150,000, including transformer banks, feeder lines, control apparatus, primary and secondary equipment, will be installed by Bureau of Water and Power, Los Angeles, Calif., in new West Hollywood station. Total cost about $300,000.

New York Metal Prices

	April 20, 1932 Cents per Pound	April 27, 1932 Cents per Pound
Copper, electrolytic	5.75	5.75
Lead, Am. S. & R. price	3.00	3.00
Antimony	5.87½	5.35
Nickel, ingot	35.00	35.00
Zinc, spots	3.10	2.95
Tin, Straits	19.33	19.45
Aluminum, 99 per cent.	23.30	23.30

N. J.-Pa. Interconnection Complete

With the going into service this month of the section of 220-kv. transmission line between Roseland, N. J., and Bushkill, Pa., delayed by litigation with several obdurate property owners, the interconnection between the lines of the Public Service Electric & Gas Company, the Pennsylvania Power & Light Company and the Philadelphia Electric Company reached its completed stage. This great Eastern high-tension transmission ring, more than 200 miles in circumference, makes available to consumers a power pool of 2,250,000 kw.

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New High-Tension Line for Illinois

Permission has been granted to the Public Service Company of Northern Illinois to construct a 132-kv. double-circuit steel-tower 17-mile transmission line in La Salle County. The new line will bring an additional source of supply to the city of Streator.

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New Plant for North Carolina?

A proposal for the erection of a six-million-dollar power plant in the Shelby district of North Carolina was presented to the Shelby City Council last week by the Fisher-Blake Company of New York, whose lawyer is quoted as saying that the company will build the plant and supply Shelby and eighteen or twenty neighboring places at a flat rate of 1.20 cents per kilowatt-hour on a 30-year contract. The estimated rating of the proposed plant is 50,000 hp.

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Potomac Edison Valuations Differ

A reproduction cost of $17,794,861 for the properties of the Potomac Edison Company, which operates in a large part of western Maryland, has been presented to the Maryland Public Service Commission by Paul L. Holland, its chief engineer. The company's electric property was valued by him at $12,409,369. The company itself placed the reproduction cost as of June 30, 1931, at $26,825,242. All these figures were presented at rate hearings now under way.

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Prepare for Carolina Rate Inquiry

The Duke Power Company has filed with the South Carolina Railroad Commission a list of all its wholesale customers, with the kilowatt-hours used by each during four months in 1931, in order that this information may be used by the commission in its power rate adjustment plans. Another list will be filed by the Southern Public Utilities Company, a Duke subsidiary. The South Carolina Power Company, the Broad River Power Company and the Carolina Power & Light Company have been asked to file similar lists. Special offices have been opened in Columbia for the new power rate division of the commission.

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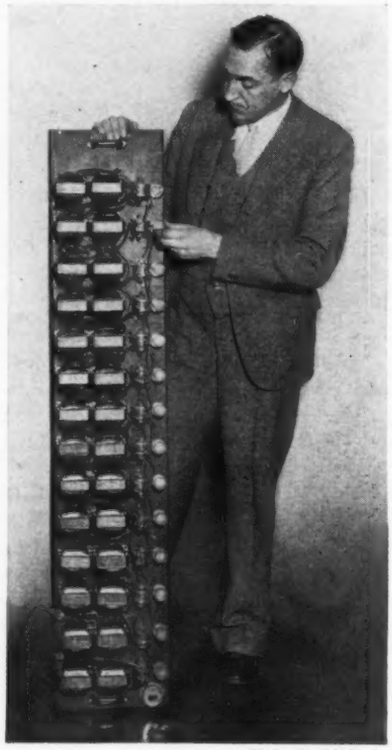
SIMPLIFIED CONTROL FOR FLASHING SIGNS



—*Wide World Photos*

Elimination of moving parts with their usual maintenance requirements was the feature of this electric sign control developed by C. G. Suits and displayed before the New York Electrical Society this month by W. A. Gluesing of the General Electric Company. Supersaturated transformers are the essential elements; d.c. controls a.c. flow.

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Federal Power Board Starts Inquiry

The Federal Power Commission will inquire into the services, rates and charges of two federally licensed power firms in Florida, the Ocklawana Reclamation Farms and the West Florida Power Company, according to an order issued last week. Action by the commission follows an informal complaint. The commission also declared its intention to exercise jurisdiction in the control of securities hereafter issued by these licensees in Florida, inasmuch as Florida has no state commission or other agency with such authority.

Drop Holding-Company Inquiry

Both branches of the Massachusetts Legislature have acceded to the request for "leave to withdraw" made by the committee on banks and banking on the petition of the Public Franchise League for an investigation by the Attorney-General of capitalization and sale of securities of public utility holding companies.

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Puyallup, Wash., Where It Was

After a three-year controversy the City Council of Puyallup, Wash., unable to sell bonds, has decided not to enter upon the distribution of energy, but will allow the Puget Sound Power & Light Company to continue in the field on its payment to the city of $25,000 to defray costs which the city incurred in connection with its public ownership plans. Dismissal of all litigation will follow, as previously indicated in the ELECTRICAL WORLD.

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Radio Interference a Court Matter

Answering a question put by the Alabama Public Service Commission, the Attorney-General of Alabama has held that the commission has no authority to order electric utilities to remove transmission lines adjacent to stores or residences to bring about the elimination of radio interference. Such matters must be decided by the courts, not by the commission, the law officer rules.

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No Diesel Plant for Brawley, Calif.

No bids have been received by the City Council of Brawley, Calif., for a Diesel-engine power plant and municipal distribution system for that city. April 7 had been set as the date for opening bids. A letter was received from the Fairbanks-Morse Company stating that it declined to bid on account of the unfavorable condition of the bond market. Melburn Mayock, a Los Angeles attorney, submitted a proposal that the city take over the distribution system of the Southern Sierras Power Company and make a contract with a corporation to be formed by him which would install Diesel engines and lease the distribution system for 25 years. It is thought there is no possibility of this proposal becoming effective.

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Marion (Ind.) Emergency Rate Case

Appraisal of the property of the Indiana General Service Company at Marion, Ind., was stopped on April 25 by Howell Ellis, member of the Indiana Public Service Commission, following a conference with Judge Robert C. Baltzell in federal court. Commissioner Ellis

does not intend to hold a final hearing in the case until the court has ruled on the utility's application for an interlocutory injunction against the emergency rate reduction of 20 per cent made by the commission last January. The reduction was suspended by a temporary restraining order. Judge Baltzell thinks it is confiscatory, though in view of general price declines, he is also of the opinion that present rates are too high. He has little doubt of the commission's right to order emergency rate reductions within reason. Two other federal judges are sitting in the case, which will probably be taken to the United States Supreme Court.

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Reports that Technique of Interconnection Improves

"Service reliability is increasing throughout the Eastern interconnected area," said C. W. Mayott, manager of the Connecticut Valley Power Exchange, at a recent meeting in Hartford of the Connecticut Section of the American Institute of Electrical Engineers. "In general, operation of power companies is now handled on a basis that permits the shutdown of the largest generating unit in any local area and also the opening of district tie lines without any marked impairment of service. About 700 miles of 220-kv. lines are now in service in the East, excluding the Baltimore-Safe Harbor transmission. Between New England and New York State the ties have a relay capacity of about 100,000 kw., and at present, on account of spring river flows, about 150,000 kw. of surplus water power is available in the Northeast between midnight and 7 a.m. So well has interconnection worked out that there has been some talk about building a 220-kv. line across Pennsylvania from east to west when conditions are favorable."

Mr. Mayott pointed out that fifteen years ago frequency control within half a cycle was about the limit of success in interconnection, whereas today variations above 0.05 cycle are regarded as abnormal for long periods of operation. Interruptions lasting longer than from two to five minutes are exceptional, although the ends of some unlooped lines cannot yet receive the same quality of service as areas having alternative sources of supply. The trend is toward more and more looping. Frequency regulation has become more a matter of adjustment for power transfer than for time service. The time error accumulated seldom exceeds one minute and usually is a matter of a few seconds. Automatic frequency control is making progress, and this is being applied at multiple points with considerable success. Six stations in the New York-New England group are equipped.

Air Conditioning Serves Many Diverse Fields

With air conditioning available, development and conduct of business need no longer be confined to those territories where climatic conditions are favorable, declared R. W. Waterfill, Carrier Engineering Corporation, speaking before the Interstate Power Club, New York, last week. But for air conditioning some tobacco and textile industries would have to limit operations to certain periods of the year or certain climates, or sacrifice uniformity of quality. Theaters, the first commercial institutions to capitalize on air conditioning, have been enabled thereby to bring their summer patronage up to or above winter patronage at a total cost of about 1 cent per seat. Department stores have been able to increase the comfort of shopping in hot weather by spending only a fraction of a cent per customer.

Human efficiency is said by Mr. Waterfill to have been a major factor in the decision to condition air for the new Metropolitan Life Building in New York, it being believed that modification and control of the temperature, humidity, purity and movement of air would reduce sickness and raise the efficiency of persons at work. The example to other institutions was another deciding motive. In addition to such modification of air, some hospitals are changing the chemical content (N, O, etc.), altering the pressure, ionizing the air and subjecting it to ultra-violet radiation so as to reproduce conditions of different altitudes and climates.

Banks, clubs, hotels, restaurants, apartments, deep mines, hothouses and meat markets are other places in which air conditioning has been found profitable. Home use, according to Mr. Waterfill, will come first in the larger and finest residences, but as rapidly as adequate, reliable, foolproof and safe equipment can be standardized so as to be sold at a price the majority can afford, there should be a big field in smaller homes. The reversed refrigerating cycle will probably have its greatest application where heating and refrigerating requirements are about equal, as is the case, for instance, along the Gulf Coast.

No one type of air-conditioning equipment is suitable for all conditions—the methods of refrigerating and distributing the air being least susceptible to standardization. Conservatively estimated, the air-conditioning load obtainable in the next 20 years should be about 4,000,000 hp., according to calculations made by Mr. Waterfill in the course of his investigation.

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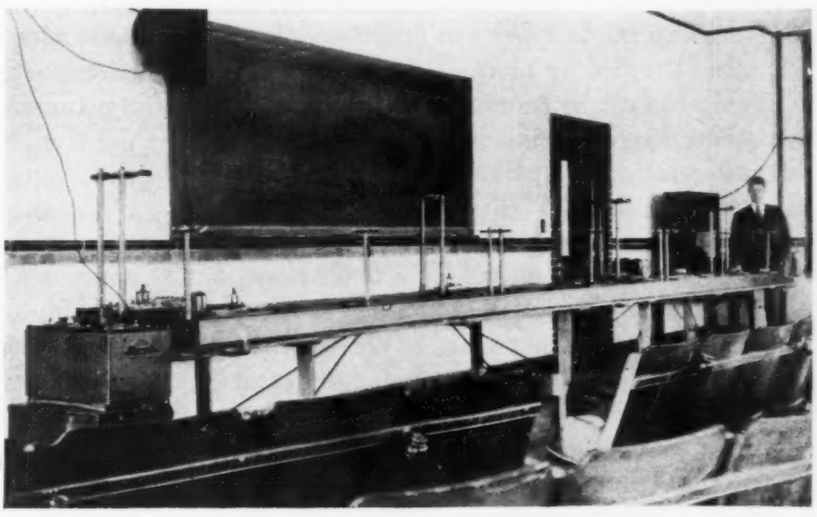
Demonstrated Phases of Inductive Co-ordination



Operators of the New England Power Association system, meeting recently at the Millbury (Mass.) load-dispatching headquarters, had from the New England Telephone & Telegraph Company an interesting demonstration of technical facts. To illustrate some of the factors concerned with the production of noise in telephonic reception and indicate the basic principles of inductive co-ordination in the joint work of utilities and communication companies, the apparatus above was shown.

The set-up consists essentially of a miniature three-phase, three-wire power line and a two-wire telephone line, the latter being connected to an amplifier and loud speaker so that the noise under various conditions can be heard in an auditorium. The power line can be energized in various ways, both lines can be transposed separately or in a co-ordinated manner, and unbalances can be inserted in the telephone circuit.

EDITORIALS

L.W.W.MORROW
Editor

Roosevelt on the power issue

IN HIS recent St. Paul address Franklin D. Roosevelt hauled out the power issue for discussion. He treated the topic in generalities and with evasion, but the general tenor was to the effect that the utilities had exploited the public and that regulation was not successful.

He did not come out for government ownership except by saying that if the government cannot find private initiative and private capital to undertake the business, then the government should step in and do it itself. Why should the government try to find the private initiative and the private capital? The outstanding development of this century is the development of power by private capital and private initiative, yet the government, according to the Governor, has just awakened to a realization that power is important to national wellbeing.

Here is another sample: Utility companies, he says, have sought "to charge rates which will bring an unnecessarily large return, not on the cash investment, but on a definite inflation of capital." Mr. Roosevelt should study just a few rate decisions to find that rates have always been based upon property value and not upon capitalization. The fundamental sought in regulating rates has always been the fair value of the property used in giving service. Rates based upon capital structure are as much a myth as the Roosevelt assertion of overcapitalization.

Another statement from this speech should be placed beside the one Roosevelt previously made about the "forgotten man." He said: "In most places in the United States the householders and the farmers and the small business men are paying vastly more for electricity than they have any right to be paying." This broad generalization and appeal contradicts the facts. It is pure political buncombe. But why go on to quote, "Public servants must restore the fundamentals of the public control," and other misleading generalities? Either Roosevelt knows nothing about the industry or he premeditatedly makes a demagogic political appeal by indicting a constructive industry.

Impulse testing comes up for standardization

LOW impulse ratio of creepage surface and the puncture of dielectric barriers point to the desirability of impulse testing of transformers to determine their ability to withstand surges. There is strong doubt at present about the adequacy of the standard low-frequency dielectric tests of the A.I.E.E. in serving as a measure of service performance of equipment under surge conditions. How can rules be satisfactory if they permit omission of the end-turn reinforcement against surges without which no transformers would be expected to give satisfactory service on high-tension lines?

But can impulse testing be reduced to a practicable prescription? Can the technique be so controlled that the evidence will leave the user content in his faith that service conditions have been duplicated? Further, can he rest secure in the assurance that no incipient failure has been left to cause disaster later when one of the vicious nature-made surges bursts in unannounced?

The answer to the first two questions will be found in the mass of data that has accrued from several years of study of both kinds of lightning —man's and nature's—and of apparatus performance in electrical storms. Surges of not over three, and perhaps only two, characteristics as to

rate of rise and duration will duplicate the range of natural surges.

The answer to the third question will probably not be discovered in the phenomena that occur during either a low-frequency or an impulse test. It will more likely rest on minute examination of models and standard production units which have been subjected to many times repeated impulses and low-frequency overvoltages. Add to this accomplishment an acceptable method of detecting the presence of corona during the tests and a way of detecting incipient failure and then there is little left to do but modify the present low-frequency requirements to produce a correlated whole. The time is ripe to put to useful purpose the knowledge that has been wrested from lightning and the equipment that it assaults.

Economics controls service extensions

CHARTERING a utility to serve a specific territory with competition excluded or restricted in that area has raised a question about the respective obligations to those who are customers and those who are outside the service area. Can a non-customer plead that any earnings in excess of reasonable amounts be devoted to free extension of the lines to the point where the financial integrity of the utility is in danger of impairment? The Connecticut Supreme Court of Errors has ruled that only the existing customers and those who are *bona fide* applicants, ready to subscribe to reasonable service extension requirements, have a right to question the reasonableness of those requirements on the general profitableness of the whole utility undertaking. Prof. Albert Levitt, who tried unsuccessfully to oust the Connecticut Public Utilities Commission on a dereliction charge in connection with grade-crossing eliminations, has thus also lost a case in which he sought a free 3,000-foot extension to his own residence.

Had the proposed principle of free extension prevailed, it would have led to a vicious situation for the utilities. First, it would have stopped absolutely the rate reductions which existing customers have enjoyed and which economy in operation and their own increased use have made possible. Second, it would have put a premium on promptness in placing applications for service extensions without regard to their relative degrees of reasonableness. Third, it would have obliterated entirely from utility regulation the principle of fixing charges for service in some degree commensurate with the cost of rendering that service.

The decision confirms indirectly the right of the utility to impose reasonable requirements for contributions toward extensions that otherwise would remain indefinitely unprofitable or even involve outright loss. It also puts utility service on the basis of the greatest good to the greatest number and not on the basis of mere map area. The risk that marginal earnings would by court decree be allocated to promiscuous service extensions over chartered areas has thus been squelched. Marginal earnings remain the joint property of the stockholders and the customers, each sharing under the prevailing philosophy of rate regulation. Nor does the ruling throttle the orderly extension into lean territory under provisions that prevent capital waste on extensions that will not for many years pay their own way.

Low price will not replace salesmanship

A COMMON fallacy in business thought is the conception that low price is an essential to sales and of itself will make sales. Sales are made because demand has been created and because salesmen can earn money by selling something. Experience shows that low energy rates in themselves will not bring about home electrification. Neither will low prices sell adequate wiring or electric appliances. Low price merely widens and expands sales possibilities in a market after demand from buyers has been created.

One of the causes of stagnation in domestic market development is price consciousness. This lesson has never been learned despite repeated examples. It takes as much if not more money to create a consumers' demand and to get sales results as it does to manufacture a product that is to be sold in the market sought. In this pioneering or introductory period selling is expensive and distribution costs are high. Success in selling is contingent upon large margins. Only after a consumers' demand has been created can

prices be reduced through lower costs of distribution. Vacuum cleaners became accepted in the era when they were manufactured for about $8 and sold to consumers for $75. The refrigerator went over the top when the factory cost of about $85 became the consumer price of $250. Margins were available in the pioneering period to create demand by consumers through advertising and specialized selling. After this period prices fell and different and more economical methods of distribution became effective. What is needed to develop the domestic market right now is money to create a consumers' demand for home electrification and household electrical products and money to pay salesmen so that they will supplement other methods for arousing this demand by carrying personalized selling into each home. This money will have to be donated by some good angel or it will have to be charged as a sales cost against the products that make an electrified home. It is time to replace fallacious ideas about low prices with true conceptions of effective merchandising in consumer markets.

"Dividing the business" —an expensive luxury

SEVERAL years ago a bright young engineer sold an idea to the management of the organization for which he worked, which was concerned with steam-power-plant equipment. By a carefully co-ordinated series of design elements a major product was made less bulky, more efficient, to demand less maintenance and so on. The industry was apathetic to the claims made, and rival manufacturers were belligerently incredulous, but the equipment did its job.

Today acceptance of the performance standards of this equipment by its users is so widespread that rival manufacturers are called upon to produce comparable results, which, without the essential co-ordination of basic ideas, they find it almost impossible to do. The standards set by the equipment are so high and the advantages so marked that rivals agree to duplicate performance regardless of the probability of being called upon to prove their ability to meet their promises.

The pioneering manufacturer whose idea triumphed watches competitors fattening on his courage and ideas, while, because of the expensive whimsy which makes purchasers "divide the business," he partakes of lean comfort. This "dividing the business" is a poor way to secure the desired results unless those competitors among whom the business is divided are truly on a par as to value of services and equipment offered. Ultimately, of course, it is the purchaser who suffers.

Attacking insulator corona

A RECENT A.I.E.E. paper by F. B. McMillan on radio interference and insulator corona points to a distinct advance in technique of investigation. Further, the use of oscillographic and audio-frequency analyses of corona formation on pin-type porcelain assemblies may lead in due course to practical steps in improvement of design, provided that the changes indicated by such studies of very minute electrical quantities do not set the stage for cracking through the addition of too large masses of porcelain to insulating units.

Professor McMillan's research was confined mainly to pin and pedestal insulators rated at from 66 kv. to 73 kv. Audible tests were obtained with a high amplification radio receiving set, and graphic records of great interest were secured with the low-voltage cathode-ray oscillograph. According to the author, corona current maxima seldom exceed 40 micro-amperes for normal voltage on a standard 66-kv. insulator. To get rid of the smothering effect of the insulator charging current, which may be 100 times the corona current value, a balancing circuit was devised in the tests to wipe out the influence of the charging current upon the deflecting element of the oscillograph.

While it is probably too early to forecast definite trends in pin-insulator design based on methods of preventing radio interference from corona formation, engineering thinking is occupying itself with such matters as the possible elimination of regions of overstressed air, the use of conducting coatings as flux distributors and the possible application of insulating compounds. Various objections must be overcome before far-reaching improvements can be achieved, and in some quarters it is believed that radio interference by insulators on live lines has been somewhat exaggerated as a practical problem.

Harvey Crowley Couch

WHEN the Mississippi River went on a rampage in 1927 and Herbert Hoover, then Secretary of Commerce, took charge of the initial task of rescue and restoration, the coming President was impressed with what he called the "great constructive work" of Harvey C. Couch of Pine Bluff, Ark., president of the Arkansas, the Mississippi and the Louisiana Power & Light companies and a foremost figure in the development of the Southwest. Probably it was his close co-operation with Mr. Couch in those days, with a resulting personal friendship, that led Mr. Hoover in September of last year to appoint this Arkansas Democrat representative for his state on the President's Organization on Unemployment Relief and again, in February last, to make him a director of the new Reconstruction Finance Corporation, from which so much is expected.

Once more the Father of Waters flows unvexed to the sea, and the work of electrical and industrial development which Mr. Couch has so much at heart goes on with only such interruption of its steady growth as hard times inflict. Carpenter Dam has been added to Remmel, the Sterlington gas-fired plant in Louisiana has tripled in size, and the beneficent tentacles of the transmission network have now grasped Tennessee, joining Memphis with New Orleans, and have reached westward into Oklahoma. In this work Mr. Couch has been first and foremost, and because of it and other things his fellow Southwesterners have bestowed upon him the title of "empire builder."

Born near Magnolia, in southern Arkansas, 55 years ago, the eldest son of a farming preacher who had a numerous family and a diminutive income, Harvey Couch started life with no assets except industry and self-reliance. He worked in a cotton gin and a drugstore, attended a local "academy," passed a Civil Service test and became a railroad mail clerk. Then, still in his early twenties, he borrowed money to string a telephone line between McNeil, Ark., and Winnfield, La.; built it up till it reached from lower Louisiana into Oklahoma, Arkansas and Missouri; sold it to the Bell system; took hold of a small electric plant in De Queen, Ark.; bought another at Malvern, getting free fuel from a sawmill, and built a transmission line to Arkadelphia. Thus, in picturesque style, true to American tradition, his career, with him upon it, was launched. Soon strong financial companies became interested, and with their backing the rest was doubtless easier.

Apart from the light and power field, Mr. Couch's business and public activities have been many. He is also a country banker on an extensive scale. He is a past-president of the Southwestern Division of the N.E.L.A. The faculty responsible for his creative success in the South is confidently expected in Washington to prove a great asset to the nation in the present emergency.

Synchronous Motor Driv

For copper rolling the synchronous motor now takes its place in continuous reversing duty.

Overbalancing the longer reversing period of the synchronous drive are its definite savings in first cost and in space requirements and its greater efficiency as against induction motor or direct current drives.

By S. P. BORDEAU

Electric Machinery Manufacturing Company, Minneapolis, Minn.

IN ITS first application to continuous reversing rolling mill drive the synchronous motor now makes its début. The installation is in the plant of the Dallas Brass & Copper Company at Chicago, Ill., and the rolling job is the breaking down of copper cakes into strip. The synchronous motor has heretofore been considered unsuitable for any continuous reversing drive. In this installation, however, the operation has proved entirely satisfactory, giving results better than originally expected. This reversing motor replaced a unidirectional motor on a mill formerly operating as a "pull-over" mill; that is, the copper cake was formerly brought back to the entering side of the mill after each pass. Replacement with a reversing motor was made to improve operation and increase production in the break-down operation.

To be considered at all, the synchronous motor had to reverse in a maximum of five seconds. A longer reversal period would have penalized production. This reversal period is considerably longer than is allowed in steel mill blooming practice. Actually the synchronous motor in this installation can be reversed in 4½ seconds, which has proved to be equal to or less than the time required to adjust the screw-downs and manipulate and re-enter the metal. As will be seen from the typical recording meter chart, speed of reversal is usually quicker than required for re-entering the metal. Rolling speed with the synchronous motor is, of course, absolutely constant. Adjustability of speed was not required on this mill. Production on the former mill was about twenty cakes per hour. This has been stepped up to 30 cakes per hour by use of the reversing motor.

Synchronous motor equipment was lowest in first cost, being appreciably lower than wound-rotor, induction motor reversing drive and about one-half as costly as d.c. equipment. Installation cost for the synchronous motor was comparatively low because of the simplicity of both motor and control and the smaller floor space it required. The synchronous motor drive required approximately 140 sq.ft. less floor space than d.c. motor drive and generator set equipment.

In electrical efficiencies the synchronous motor has some advantage over a reversing slip-ring induction motor, as shown by the accompanying curves. At full load efficiencies are nearly equal. At part loads and idling, however, synchronous motor efficiencies remain comparatively high. A wound-rotor induction motor would reverse at somewhat better efficiency than the synchronous motor, but the latter has lower losses than the induction motor when operating in synchronism. Efficiency of the synchronous motor (including losses of the ventilating blower) is 95.5 per cent at full load, 75 per cent when idling.

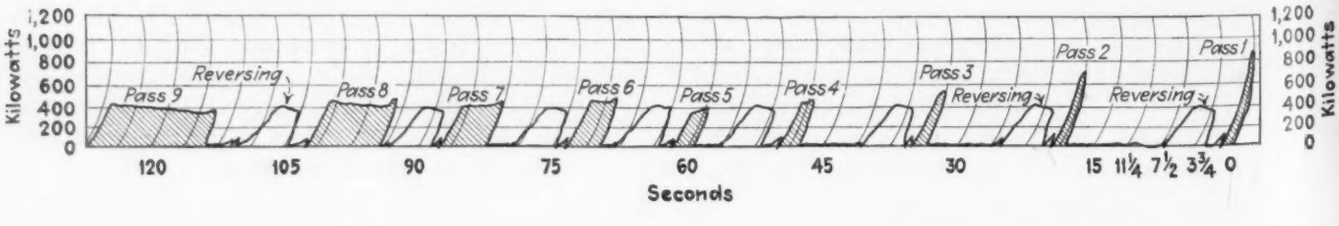
Compared to the d.c. reversing drive, the synchronous motor shows considerable saving because of higher electrical efficiency. This is a result, of course, of the losses in transforming alternating current to direct current in the motor-generator set. The average saving in energy resulting in this installation from the higher efficiency of the synchronous motor drive over d.c. equipment would approximate $3 per eight-hour working day.

At full mill operation the synchronous motor runs 50 per cent to 70 per cent of the time at unity or leading power factor, the remainder of the time, during reversing, at approximately 25 per cent lagging power factor. With the mill operating at less than full schedule a greater portion of the operation is at leading power factor. The comparatively high kva. at lagging power factor during reversing is offset by leading kva. from other synchronous equipment in the mill.

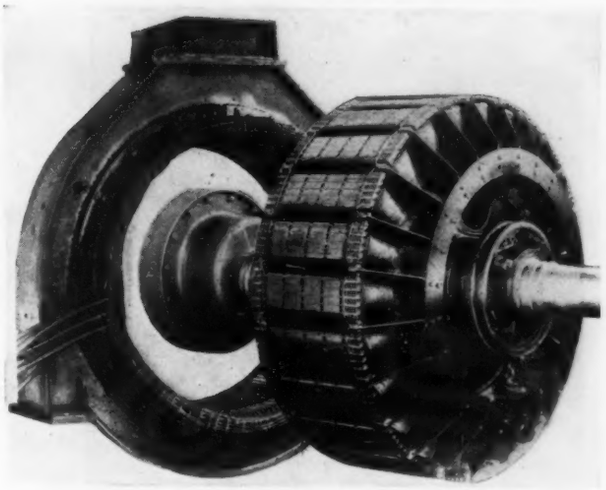
With synchronous motor equipment energy peaks during metal passes and during reversing must come from the power line, whereas with d.c. motor and flywheel motor-generator set peaks could be largely absorbed. This factor was of no importance in this installation because the power system backing up the mill was sufficiently large to handle the peaks very easily. The load peaks do not, of course, affect maximum demand charges

Reversal time less than make-ready time

This chart shows how the 600-hp., 300-r.p.m. motor broke down a copper ingot 4⅝ in. thick, 14 in. wide and 30 in. long to a sheet ¾ in. thick, 16¼ in. wide and 40 ft. long in nine passes through the mill. The cross-hatched areas show the energy used in rolling and the open areas the power required for reversing the motor. In terms of motor rating the short-time first pass imposes a 100 per cent overload, but the overload disappears after the third. Heavier passes could be taken without exceeding the motor torque or heating capacity. The motor is in synchronism approximately 95 out of 130 seconds, or 75 per cent of the rolling cycle.



Drives Reversing Mill



Special features of motor design

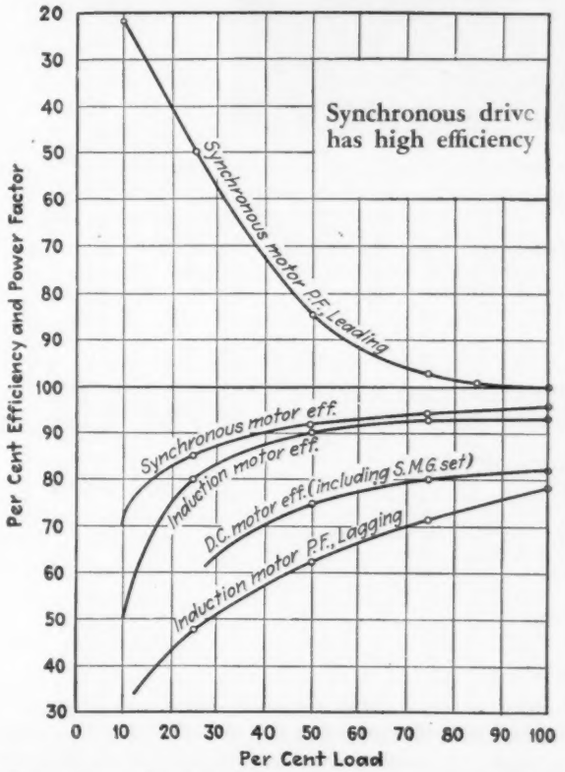
This separated view of rotor and stator of the reversing synchronous motor shows design features for rapid dissipation of heat—fin construction of end ring, for strength against continual reversing and to minimize flywheel effect—welded steel rotor spider.

because they are momentary, whereas demand indications are averaged over a period of fifteen minutes. The effect of load and reversing peaks on voltage regulation is negligible.

Maintenance expense with the reversing synchronous motor has proved to be low. The control, of the air-break contactor type, is extremely simple and requires only an occasional dressing of the contacts to keep them in working order.

The synchronous motor should give, and promises to give on this reversing installation, reliability entirely equal to that of other types of motor drive. Inspection of constructional details, shown in the disassembled motor illustration, will show that there is little possibility of motor trouble which would cause mill shutdown. Although the illustration reveals several special features to permit dissipation of heat, to withstand the stress of continual reversing and to minimize flywheel effect, in the main no radical fundamental departure was made from the standard synchronous motor.

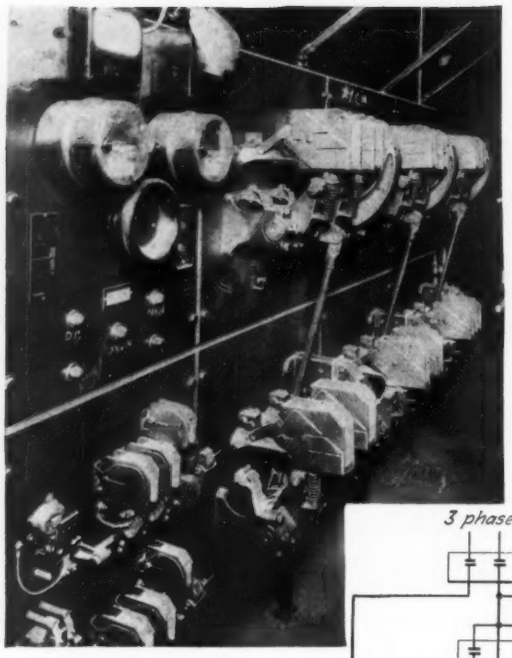
The stator is of fabricated steel construction, built to provide adequate ventilation. Armature coils are mica insulated and securely lashed to minimize vibration. The rotor spider is constructed of steel plates to secure lightness and strength. Field coils are strap-wound and asbestos insulated. To prevent undue heating of the



Compared with the induction motor the synchronous drive has higher efficiency and better power factor than the d.c. drive including conversion equipments.

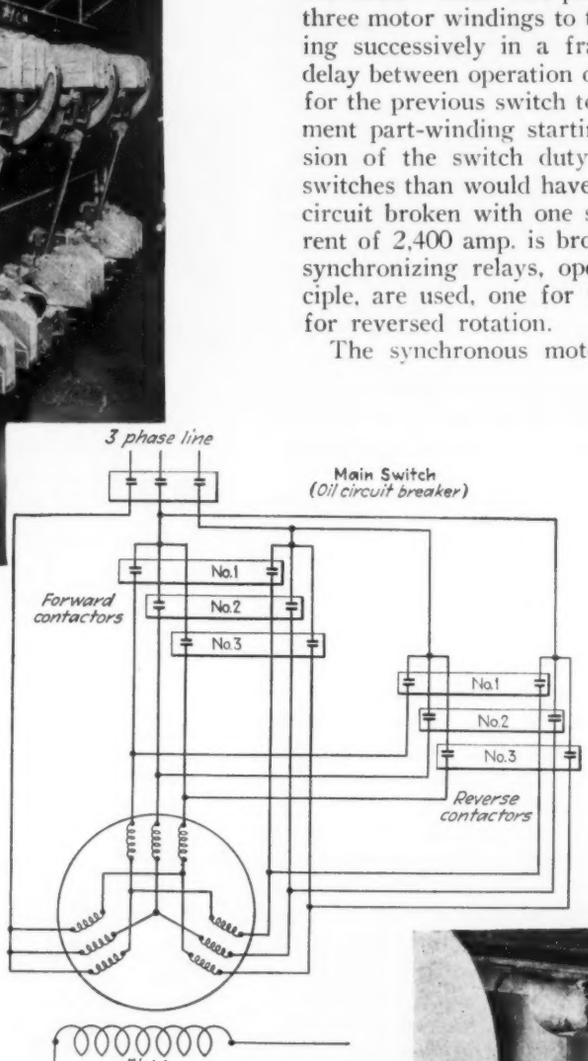
Speedy synchronizing

The notations A, B and C indicate contactor closings and show that the triple-winding design, even though contactor operations are speeded up, still tapers off the current inrush to some degree during reversals. This is a current, not a power, oscillogram.



Control in small space

The single panel at the left carries meters, overload and synchronizing relays and field contractors. On the other panels are the mechanically interlocked starting and reversing contacts.



Motor and control circuit

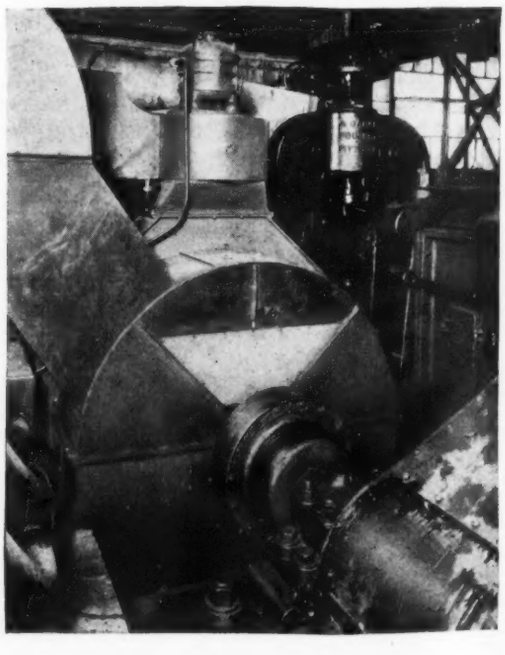
Making one phase connection common to all three motor windings permits saving by use of two-pole contactors. Because the time intervals between contactor closings are as short as can be made, the motor operates practically as a single winding machine. The value of the triple winding is that it allows the use of three smaller contactors in place of a more expensive one of three times the capacity.

air-break contactors. One of the three primary leads is in common, hence two instead of three-pole contactors are used. Each two-pole switch connects one of the three motor windings to the line, the three switches closing successively in a fraction of a second. The time delay between operation of switches is only that required for the previous switch to close. This short-delay increment part-winding starting was used to permit subdivision of the switch duty and to permit use of lighter switches than would have been necessary were the entire circuit broken with one switch. The total starting current of 2,400 amp. is broken into 800-amp. steps. Two synchronizing relays, operating on the frequency principle, are used, one for forward rotation and the other for reversed rotation.

The synchronous motor has definite limitations for large reversing mill service. This installation, however, shows its suitability for certain smaller metal rolling mills where constant speed is satisfactory and where a reversing period of four to five seconds does not handicap production. For these smaller reversing mills, requiring motors approximately 1,000 hp. or less, the synchronous motor offers considerable savings in first cost and in operating cost. This installation also is impressive evidence of the ruggedness and high-torque characteristics of modern synchronous motors.

Compact installation

To the right, and back, of the inclosed motor is the top of the roll stand. In the foreground is the drive pinion end of the reduction gear. Note ventilation blower motor on top of synchronous motor housing.



field pole cores during reversal, they are made up of thin sheet steel laminations instead of the usual heavier gage sheet. To permit rapid dissipation of heating in the cage winding the end ring is constructed of several fins, each welded to the cage bars. These fins present a honeycomb structure, with large area for removal of heating in the bars.

Forced ventilation is obtained by a blower mounted on the opening on top of the stator. Complete inclosure of the motor was found unnecessary for cooling, and during the first few months of operation inclosed end-bells were not used. Later it was found that because of the proximity of the motor to the mills copper dust was being drawn into the winding, and to prevent this end-bells were provided with an inlet which tapped cooling air from the outside.

The motor is reversed by a two-way master switch with indicating lamps, placed near the mill. Part-winding starting is used, the motor being wound with three parallel circuits. Overload protection is furnished by an automatic oil circuit breaker in the main feed. Reversing is accomplished by two sets of three two-pole

Small Devices Important in Automatic Operations

Fuses, relays, resistors, etc., and their connections to larger equipment play a large part in the performance of automatic substations and poor quality or design must frequently be blamed for service outages, according to O. M. Ward,* superintendent of operation Milwaukee Electric Railway & Light Company. He says: "The operating experience of the Milwaukee Electric Railway & Light Company indicates that service availability of manually controlled equipment is slightly higher than service availability of automatic substations.

"Most faults resulting in service failure in substation equipment can be easily and quickly repaired, or if they are of the cumulative type, requiring a certain period of time to develop, in some cases days, before actual failure occurs, the attendant at manually operated stations in most cases quickly makes repairs with little or no delay, or notices the potential faults and corrects them without inconvenience to or knowledge of the ultimate consumer. This is really the important thing to consider. On the other hand, similar abnormal conditions in an unattended automatic substation may, and in fact often do, cause prolonged machine or other equipment outages.

"Failures of small and relatively unimportant equipment such as fuses, relays, resistor units, etc., in automatic substations are very much more serious than the failures of similar equipment in manually operated stations. Many standard commercial articles are not suitable for use in automatic stations. Take, for example, the fuse. No doubt every one has had one open up occasionally for no apparent reason. Ordinarily this is a matter of little inconvenience and is not worth much of an expenditure to correct. For general average purposes the present-day fuse appears to be reliable enough and there appears to be no reason for suggesting the redesigning of it. In an attended station an open fuse rarely affects service to customers, but in automatic stations such an occurrence often results in service outages.

"Other pieces of equipment that may be included with fuses in the list of undesirables are some standard relays and small resistor units, particularly those in circuits normally energized. Relay windings and contacts are not sturdy enough or they are not sufficiently protected to withstand abnormal circuit conditions, brought about by lightning or voltage surges due to other causes. Sufficient attention is not given to securing bolted connections to prevent their loosening. Resistor unit failures appear to be due to improper control of material during the manufacturing process."

*See his paper "Mercury-Arc Rectifier Versus Rotary Converter Automatic Railway Substation," presented at the Great Lakes District, A.I.E.E., meeting in Milwaukee.

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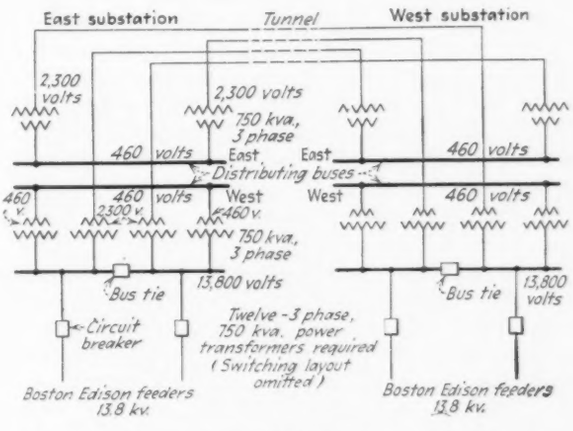
Cross-Feeding Between Substations Aids Service Continuity

To insure continuous energy supply for light and power in the new Boston traffic tunnel an effective method of duplexing feeder service has been devised. Between portals at East Boston and the city proper the tunnel is about 5,700 ft. long, passing under Boston Harbor. Ventilating buildings are located about 900 ft. from each end and these are utilized as distributing substations. In each substation it is planned to take power at 13.8 kv. from a transmission loop of the Boston Edison Company. In each substation the loop will connect with the ends of a sectionalizing 13.8-kv. bus, the bus and tie forming a part of the loop as shown. On each section of the bus will be two 750-kva. transformers, one supplying a 460-volt bus in the same building, while the second feeder will supply a 2,300-volt line to the substation on the opposite side of the harbor. This last voltage is again reduced at the latter point to supply a 460-volt bus. By this arrangement each building will be supplied with two 460-volt buses, one bus in each substation having two sources of power in the substation at the opposite end of the tunnel and the other bus in each building having two local sources of power.

Feeders for utilizing all energy required will be taken from these 460-volt buses through selector switches not shown in the diagram, the switches being electrically and mechanically interlocked to permit feeding local power, heating and lighting circuits (including appropriate lighting and auxiliary transformers) from either 460-volt bus, but making it impossible to tie the 13.8-volt loops together. Four Edison feeders will thus be available directly or indirectly at each end of the tunnel. The 460-volt buses in each substation are not provided with tie switches, but the power and lighting loads may be divided between them or carried by one bus as desired.



Basic scheme for reliable power supply to Boston traffic tunnel

With three Edison feeders out of four cut off from the tunnel one bus in each substation can be kept alive by the fourth 13.8-kv. feeder to carry the service connected to that 460-volt bus. Provision has also been made for emergency direct-current lighting service.

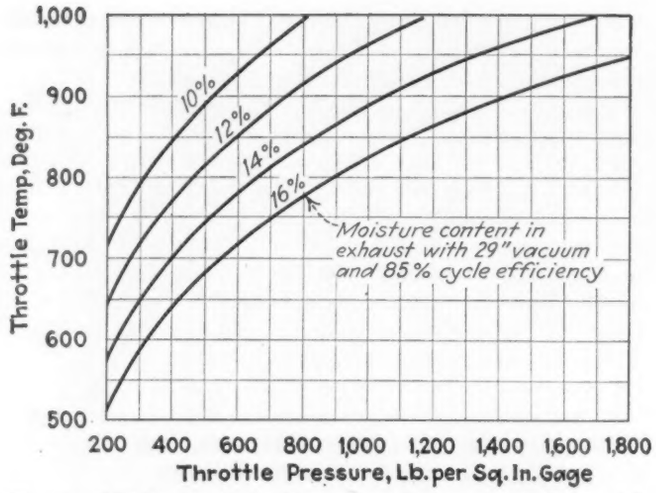


Fig. 1—Minimum throttle temperatures permissible without reheat to avoid excessive moisture in low-pressure stages

THERE seems to be discernible a trend away from the complication in plant layout and initial expense incurred by reheating steam. When reheating is not employed the moisture content of the steam exhausted to the condenser becomes a limiting factor, requiring for each inlet pressure and each cycle of regenerative feed heating a certain minimum inlet temperature (Fig. 1).

An inlet temperature of 825 deg. F. may now be considered as established and practicable without material increase of maintenance. With 12 per cent moisture in the exhaust, which is considered the limiting value for the high peripheral speeds now employed, the inlet pressure cannot materially exceed 1,200 lb. per square inch, even assuming that 1,000 deg. F. inlet temperature were practicable. Regardless of the desire to increase this pressure, there will undoubtedly be a tendency to raise the inlet temperature. The ultimate limit in operating temperature must be associated with the type of turbine involved. Large single-cylinder machines are inherently more sensitive to thermal distortions, and a very material increase of operating temperatures beyond 825 deg. F. is not likely without fundamental changes in the detailed design of such machines. In the case of small, high-pressure cylinders of tandem-compound or cross-compound units it is not improbable that 1,000 deg. F. may ultimately become a practical operating temperature.

Development of Large Size Units—The maximum output of a condensing turbine is determined chiefly by the last row of blading. Consequently in developing large individual units there has been a gradual enlargement of the last annulus. The first impetus was given by the twisted and tapered blades whereby the ratio of blade length to mean diameter could be increased to the present values of 0.3 and more. This ratio being established, the discharge area was increased by increasing the tip speed to the present values in excess of 75,000 ft. per minute. This necessitated extensive metallurgical developments to obtain blade materials that would stand the stresses imposed and it brought about an accentuation of the erosion problem.

It is now possible to build single-cylinder condensing units in sizes approaching 100,000 kw. for operation at 1,800 r.p.m. and 15,000 kw. at 3,600 r.p.m. The same low-pressure ends used in multi-cylinder machines of the tandem- or cross-compound type will give unit capacities of twice the above values. Two-cylinder, single-shaft turbine generators of 200,000 kw. capacity for 1,800 r.p.m. and 35,000 kw. or more for 3,600 r.p.m. may thus be regarded as fully practicable at the present time.

Improvement of Efficiency—Improvement in efficiency has been particularly outstanding in the smaller sizes of turbines, although it has not been lacking even in the very largest machines. The improvement has been obtained principally through the following means: (a) Reduction of safe operating clearances in the high-pressure blading. The axial clearance type of reaction blading (Fig. 2), originally introduced by Parsons, is perhaps the most important step in this connection; (b) improvements in the form of the blade path to eliminate eddies; (c) improvements in the shape and the arrangement of the individual blades and nozzles. The essential aspects of design rest on the same fundamentals as a number of years ago, but surprisingly great improvements have been made in details. Improvements in efficiency will undoubtedly continue for several years.

Problems of mechanical strength

New and perplexing strength problems constantly confront the designer of steam turbines. On the one hand, it is necessary to evaluate the forces or deformations occurring in the stressed part and thus determine the stresses involved. Then it is necessary to appraise the consequences of these stresses in terms of failure. We do not know, in general, the combinations of circumstances which cause failure, nor do we always know what we mean, scientifically, by the term failure.

Of particular importance are the bore stresses of the rotor. In the case of thin axial disks, these have the aspect of one-dimensional stresses, but in general the application is more complicated. The bending and torsion stresses of the shafting is another group of stresses which may be of importance. The stresses in blades are due to centrifugal forces, steam forces and inertia reactions from vibrations. In general, the essential stresses are straight tension and bending. The root stresses in the blade fastenings represent a difficult type of stress application, the magnitudes of which frequently depend on accuracy of machining, methods of assembly, etc.

Problems of Turbine Design

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The magnitude of these stresses may be difficult to determine, but given a definite set of conditions, a definite solution is always available. Not infrequently, mathematical methods are of little avail; graphical and mechanical integration methods are then brought into action. Experimental methods, notably the photo-elastic method, are gradually receiving deserved attention.

It is necessary to distinguish between a state of stress which disappears through relaxation of the structure and a state which persists regardless of the ensuing deformations. To the first group belong such stresses as the assembly stresses in a disk shrunk on a shaft. The centrifugal stresses in the disk, when rotating, is a representative example of the latter type. These types of stresses must be evaluated differently in appraising their contributions to failure. Not infrequently the first group of stresses may be neglected altogether, as non-essential to the phenomenon of failure; the resulting simplification of the stress problem is an important help.

Properties of Materials at Elevated Temperatures—Strength values generally drop with increasing temperatures and ductility increases (Figs. 3 and 4). At 1,000 deg. F. practically all of the materials available at present are profoundly modified.

The actual reduction in strength is not the most important change, however. The usual permanence of the elastic properties is destroyed and the materials behave approximately as amorphous materials. This phenomenon of creep is of greater importance than the reduction in strength and must be considered in the dimensioning of high-temperature turbine parts. Unfortunately the available knowledge is entirely insufficient to make definite predictions of creep in most cases, nor does it seem likely that exact knowledge will be available very soon. Creep under combined stress is also somewhat of a mystery; at the present time it is generally assumed that only the maximum shear influences the creep.

Unless the user of equipment is acquainted with the major problems of designing equipment to meet performance specifications, he is liable to feel, at times, that the manufacturer is inherently opposed to development, or he may write specifications that handicap the best design.

This analysis* of problems confronting turbine builders should tend to overcome both, and indicate the probabilities of meeting future requirements. It treats of the limitations on inlet temperature, the importance of low-pressure blading, factors influencing turbine efficiency, problems of mechanical strength, properties of metals at high temperatures, variable and impact stresses, factor of safety, the erosion problem and materials for resisting it, vibration, etc.

Even more subtle are certain other changes. The change known as carbide spheroidization is beginning to receive attention, particularly because it has been found to affect the resistance to creep. Caustic embrittlement and similar disintegration of grain boundaries have also been associated with service at high temperatures.†

A commendable degree of conservatism has been shown, but it appears that in many cases the fear of creep has been permitted to dominate the problem too far. The modification of many materials at temperatures between 500 and 800 deg. F. are in some respects

*A more complete discussion of the subject was presented before the Engineering Society of Western Pennsylvania at Pittsburgh recently.

†R. W. Bailey and A. M. Roberts, "Testing of Materials for Service at High Temperatures," the Institution of Mechanical Engineers, 1932.

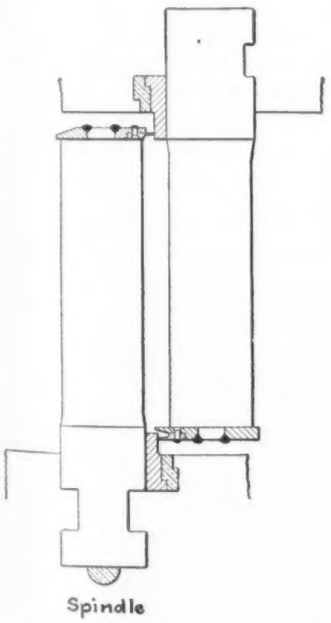
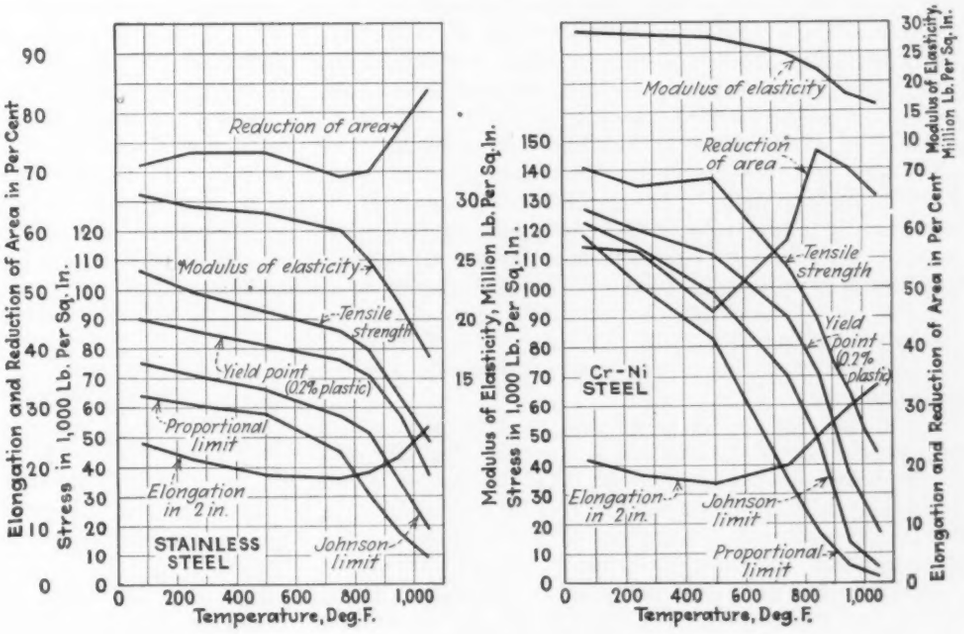


Fig. 2—Axial clearance type of blading has improved turbine efficiency

Figs. 3 and 4—How properties of two typical metals change with temperature


Elongation and Reduction of Area in Per Cent
Stress in 1,000 Lb. Per Sq. In.
Reduction of area
Modulus of elasticity
Tensile strength
Yield point (0.2% plastic)
Proportional limit
Elongation in 2 in.
STAINLESS STEEL
Johnson limit
Temperature, Deg. F.
Modulus of Elasticity, Million Lb. Per Sq. In.
Stress in 1,000 Lb. Per Sq. In.
Modulus of elasticity
Reduction of area
Tensile strength
Yield point (0.2% plastic)
Cr-Ni STEEL
Elongation in 2 in.
Johnson limit
Proportional limit
Temperature, Deg. F.
Modulus of Elasticity, Million Lb. Per Sq. In.
Elongation and Reduction of Area in Per Cent

definitely desirable. The ductility increases and with it the ability to obliterate sharp concentrations of stress. In addition, the fear of creep has, in many cases, defeated its own object by injecting objectionable temperature stresses due to indiscriminate increase in the dimensions of the parts involved. Naturally, there are many cases, such as stresses in bolts, where the results of creep tests may be applied almost directly. In most cases of relaxation, however, it is only the average stresses over certain cross-sections which need to enter into the creep problem.

Variable and Impact Stresses — The simultaneous existence of alternating and steady stress leads to various combinations of pulsating stress. A scant amount of experimental information is already available. In general, failure under alternating stress will occur sooner when a steady stress is added, but no very definite law of super-position seems to exist.

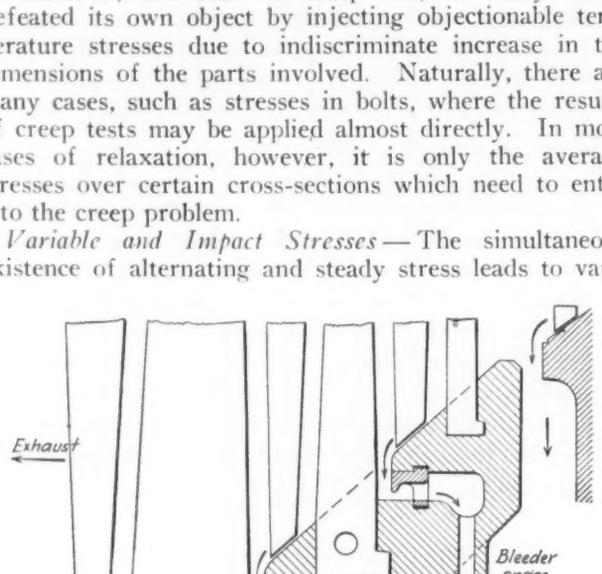


Fig. 5—Arrangement for extracting moisture from low-pressure stages

If in a tensile test piece the stress is increased to very large values in an extremely short period of time, a fundamentally different behavior will be observed. The outstanding aspect of failure under such condition of impact is that rupture takes place without plastic flow. The practical method of carrying out the tests is by breaking a notched bar in bending and recording the work done (in foot-pounds). The figure thus obtained is the impact strength. The significance of this figure is insufficiently understood, but it is associated with the cohesive properties of the material. It is a very sensitive indicator of certain faults in heat treatment and it will also reveal the existence of embrittling modifications of the crystalline structure. Ordinary tensile tests of notched specimens have been used successfully for the same purposes.

Factor of Safety—A great deal of confusion exists with regard to the "safety" of a structure. In the case of the tensile test, it is evident that, for ductile materials, the yield point represents the limit of strength; the factor of safety, consequently, is the ratio of yield point to actual stress. Something would undoubtedly be gained by expressing the safety of the structure by the "factor of utilization," the inverse of the factor of safety; 100 per cent utilization would thus represent a stress equal to the yield point.

Under alternating stress the factor of utilization is based on the endurance limit, local stress concentration playing a definite rôle. Simultaneous application of steady and alternating stress requires further definition. As mentioned before, no true condition of superposition seems to exist between variable and steady stresses existing simultaneously. In spite of this, however, it is becoming customary to determine the factor of utilization by direct superposition. Thus, if a material having a yield point of 60,000 lb./in.^{2} and an endurance limit of 40,000 lb./in.^{2} is subjected simultaneously to a steady stress of 30,000 lb./in.^{2} and an alternating stress (including stress concentration) of 10,000 lb./in.^{2}, the factor of utilization would be $0.50 + 0.25 = 0.75$. The factor of safety would be $1/0.75 = 1.33$.

When the phenomenon of creep becomes important, it is no longer a question of strength but of stability of dimensions; the problem of creep completely dominates the situation. The permissible stresses are determined on an assumption of the life of the machine and the rate of creep during its life. On this basis, practical creep rates have been proposed for various turbine details, varying from 10^{-9} per hour for rotor disks to 10^{-7} for pipe joints.‡

The Erosion Problem—The amount of erosion is a function of both the degree of moisture and the impinging velocity. Presumably, the size of the drops and the pressure also enter into the phenomenon, but the actual relationship is not very well understood as yet. There is no uncertainty about the seriousness of the problem, however, because this erosion is at the present time the chief factor in limiting the peripheral speed, and thus the exhaust annulus, of large turbines.

The erosion problem has been given considerable study in the last few years. The most important methods of approach are: (a) Increasing the absolute velocity of the water by reducing the drop size; (b) draining the moisture from the blading; (c) increasing the erosion resistance of the blading material. No satisfactory method has been found to accomplish the first object, but a certain measure of success has been obtained by draining out the precipitated water (Fig. 5). A somewhat superficial check of one machine some time ago indicated that about 25 per cent of the total moisture precipitated in a row may be drained off in this manner.

The most important and most effective aspect of the erosion problem, however, is to make the blading impervious to the bombardment of the water drops. It has now been agreed for some time that, beyond the use of stainless steel, it is impractical to employ a blade material of sufficient inherent hardness to be impervious to the erosion. This leaves as the only alternative a protective shielding of some kind.

Chromium plating in thicknesses up to 0.005 in. has been used for some time with a certain measure of success. It is a very expensive method, however, and the question of renewing the coating is troublesome. There have been arguments about the embrittling action of these extremely heavy platings, but this is not yet fully explored. Recent tests indicate that a certain embrittling may occur.

‡*K. Baumann, "Some Considerations Affecting the Future Development of the Steam Cycle," the Institution of Mechanical Engineers, 1930.*

Nitriding the blades on the inlet edges has also been used with satisfactory results as far as erosion protection is concerned. Nitriding the thin edges leaves them very brittle, however, and the method has not come into general use. Nitriding the thick inlet edges only is a possibility, and when applied in this manner the method has attractive possibilities.

Separate shielding strips applied to the blades by welding or soldering were used by the Parsons Company in England several years ago. The method has been very thoroughly investigated in America and it is now regarded as the most favorable solution. A tremendous variety of protective shieldings has been tried, of which may be mentioned tungsten, tantalum, stellite, contracide, resistal and numerous others. Tantalum and stellite are the most promising, particularly the latter, having given excellent results in service on some large units. With this method of erosion protection, blades with tip speeds exceeding 1,200 ft. per second will now give the same service as ordinary stainless steel blades for tip speeds of the order of 900 ft. per second.

A great deal of valuable operating experience is now being accumulated on the subject of erosion. One of the turbines of the Duquesne Light Company, for example, is equipped with some 30 different kinds of shielding materials.

Erosion protection received its most important impetus from the development of an erosion tester. Such a tester has been in operation for some time and a large volume of valuable results have been obtained. Comparative results (Fig. 6) for stainless steel and stellite with impinging speeds of 1,000 ft. per second and 1,200 ft. per second are shown. The evidence in favor of stellite shielding is very pronounced. Of particular interest is the fact that this erosion tester has so far confirmed in every detail the evidence gathered from machines in actual operation.

The Problem of Materials—No one factor has affected the development of steam turbines more profoundly than the metallurgical problem. Materials have not always been judged by rational standards and many expensive developments have led to blind alleys, but the progress has, nevertheless, been outstanding.

Several important alloy steels are now used for rotors. Nickel-molybdenum steel (2.5 per cent Ni, 0.25 per cent Mo, 0.4 per cent C) has gained an important place for this purpose. It is now possible to obtain forgings of

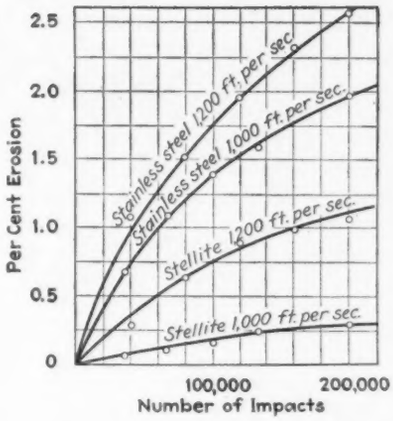


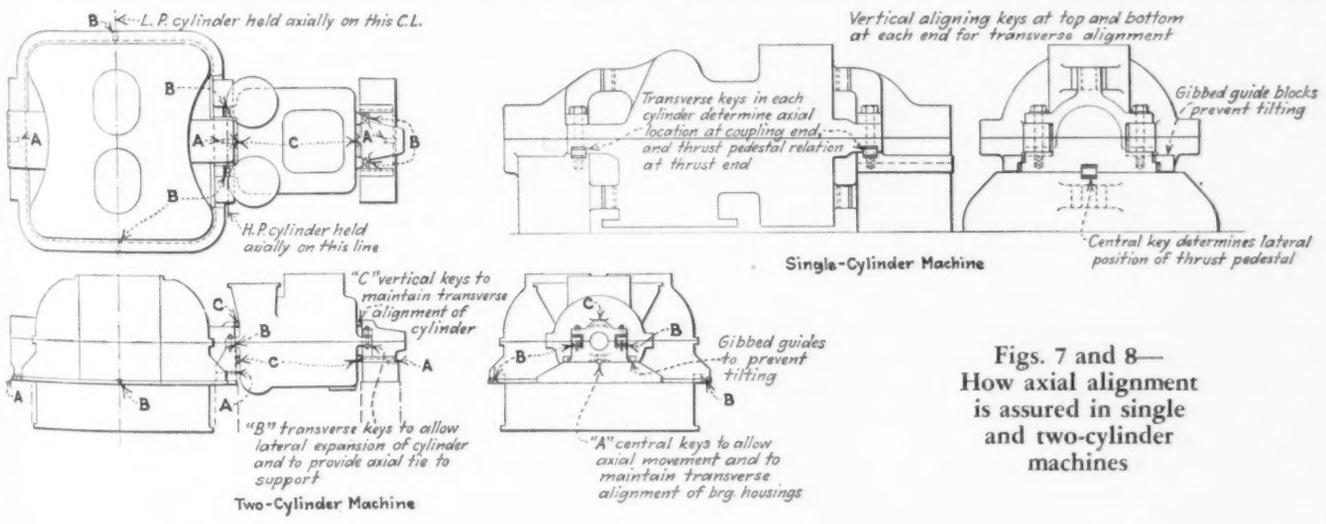
Fig. 6—Relative resistivity of two metals to blade erosion

75,000 lb. with a yield point of 60,000 lb./in.² and a reduction of area of 40 per cent in the tangential direction near the rotor ends. Rotor forgings of still greater weight are required, however, so that certain rotor constructions have been made with a transverse joint at the high-pressure end. On more recent construction this joint has been moved to the low-pressure end instead.

While these constructions have given a good account of themselves, it is, nevertheless, desirable to eliminate such joints. The solution of this problem appears to be to mount the heavy blade rows on disks, shrunk on the shaft. The central part of the rotor can then be made of a relatively inexpensive carbon steel, except for high-temperature applications, where an alloy steel must be used. In the comparatively small sizes required for these disks the Ni-Mo steel, with the analysis mentioned above, may be given a yield point of 80,000 lb./in.² and a reduction of area of 40 per cent.

One of the outstanding properties of the Ni-Mo steel is that in large forgings the physical properties are maintained under high temperatures. The strength is better sustained at the higher temperatures than for any other similar material and the creep is smaller. It is not difficult to obtain special alloys with superior physical properties in small pieces, but when the forging problem is considered with the risk of segregation the Ni-Mo steels have been found outstanding.

Stainless steel (12 per cent Cr, 0.5 per cent Ni) is accepted as the best material for practically all applications of blades. Its qualities of strength are such that it is generally used for the large low-pressure blades. The austenitic materials (for example, 20 per cent Ni, 7 per cent Cr) also have their applications where corrosive conditions are detrimental to standard materials.


L.P. cylinder held axially on this C.L.
H.P. cylinder held axially on this line
Vertical aligning keys at top and bottom at each end for transverse alignment
Transverse keys in each cylinder determine axial location at coupling end, and thrust pedestal relation at thrust end
Gibbed guide blocks prevent tilting
Central key determines lateral position of thrust pedestal
Single-Cylinder Machine
"C" vertical keys to maintain transverse alignment of cylinder
"B" transverse keys to allow lateral expansion of cylinder and to provide axial tie to support
Gibbed guides to prevent tilting
"A" central keys to allow axial movement and to maintain transverse alignment of brg. housings
Two-Cylinder Machine

Figs. 7 and 8—How axial alignment is assured in single and two-cylinder machines

The difficulty of machining, however, is a serious handicap of these materials.

Forging has been the common method for the more complicated blade shapes, but milling is now gaining in importance. Considerable progress has been made recently with milling blades from special rolled shapes.

Blade erosion has brought about considerable development in shielding materials of controllable hardness.

The standard nitriding steels, especially the Cr-Al-Mo type, possess very interesting possibilities. The erosion protection is very satisfactory and their fatigue properties are above those ordinarily found for very hard materials. An equivalent Brinell hardness in excess of 900 is now obtained. Where the shape lends itself to the process it appears very promising.

Stellite represents a group of alloys composed of Co-W-Cr-Fe which also have proved to possess outstanding properties in this respect. The Brinell hardness is of the order of 550, after being secured to the blade. Greater hardness may be obtained, but then the brittleness becomes too great. Originally, attempts were made to deposit stellite by welding to the back of the blades and this method has been applied successfully on blades of limited lengths. For very long blades, however, experience has shown that silver soldering of rolled strips is a more satisfactory method.

Hardened tantalum has also given good erosion performance, but this material is somewhat too expensive, the hardness generated by the usual treatment is very shallow and the permanence of the erosion protection is not yet proved.

Arc welding is now gradually replacing silver soldering in certain important blade details. The weld rod used for this purpose consists of 18 per cent Cr and 8 per cent Ni and is coated with a special flux. Another important development is the depositing, by arc welding, of monel metal, stainless steel, stellite and other materials on valve seats. By this process it is possible to use cast steel for the valve body, on which may be deposited a seating material of suitable qualities.

Vibration Problems — Most vibration troubles are caused primarily by unbalances in the rotating masses. The ways by which these unbalances are brought about are numerous and many are as yet only imperfectly understood. There are very few cases in which the balancing process itself offers serious difficulties, but the permanence of balance and alignment is a subject which has been given a great deal of attention during the last few years. It was observed long ago that the intensity of vibrations varied in a very erratic manner on certain machines. Vibration troubles of this type are often baffling; certain instances will always remain mysteries and others are cured by seemingly trivial changes.

Certain details of design have been found of particular importance. One of these details is the concentricity of the bore of a rotor spindle with a central hole. It is evident that a temperature gradient between the inside and the outside in such a case will give rise to a change in curvature of the neutral axis of the spindle. This curvature may not be large, but if it occurs in the gland region of a large turbine spindle the ensuing unbalance and change of alignment may not be admissible. As a result the accuracy of central bores of spindle forgings is now held to very close limits.

Another important source of trouble of a similar nature is faulty design of the stationary parts to take care of thermal expansion. In high-temperature machines the thermal expansions of the various parts of the turbine may be very large. The suspensions of the high-pressure cylinders and bearing pedestals must be such that this expansion is facilitated. A great deal of progress has been made in this respect during the past few years.

An arrangement that has been used with outstanding success on several recent single-cylinder machines operating at 825 deg. F. inlet temperature is illustrated (Fig. 7). It has been evolved for end-tightened machines where the axial alignment between cylinder and spindle is of particular importance. A similar arrangement for a two-cylinder, tandem-compound machine is also shown (Fig. 8).

Permanence of alignment is best secured if the heating and cooling curves of the cylinder and the spindle are identical.

When details of the above nature have been taken care of satisfactorily there is still the problem of designing the rotating and stationary parts so that reasonance is avoided. However, the circumstances leading to resonance are well known and troubles can usually be attributed to a neglect in using the available knowledge. On the other hand, the problem of blade vibrations is much farther from its ultimate solution. Less is known about the frequencies and magnitudes of the impressed forces; moreover, the possible modes of vibration in groups of long blades are very numerous. Under such circumstances the designer is often at sea in his choice of fundamental considerations of design. Nor is direct experience a very valuable guide. At most, it can prevent the recurrence of similar blade failures, but with the difficulty of accurate observations it rarely gives aid in predicting the behavior of fundamentally new designs.

Under these circumstances it has become necessary for the turbine manufacturers to obtain the required experimental results by model tests under laboratory conditions. A great deal of such experimental work is going on at the present time. The most rational of these test methods subjects the assembled blade groups to impulses of known intensity and frequency and the resulting motions are observed. The old hammer test is simple, but is still a useful form of blade testing.

Critical speeds of rotor structures have ceased to have the importance they did several years ago. For a long time the fear of passing through critical speeds actually retarded the development toward large units. Gradually, the demand for lengthening of the machines, particularly the generators, became so insistent that the restrictions due to critical speeds were waived. No particularly deplorable consequences can be traced to this step, although even today many turbine designers do not deliberately design their machines to pass through the critical speeds. Many types of designs are still in a stage where this is not even necessary.

The introduction of end tightening of reaction blading brought about a simplification of the problem of passing through a critical speed, since the vicious results of radial-blade rubbing contacts in the middle of the machine are eliminated.

The problem of critical rotor speeds is complicated in very large machines by the fact that the structure of the entire machine takes a part in the vibrations. The relative rigidity of foundations and bearing supports diminishes as the size of the machines increases, so that for

the large machines the actual critical speeds are much different from the calculated values. The problem must now be treated as a foundation problem and the phenomena become very complicated. This may be appreciated when it is remembered that any large machine passes through a number of critical speeds in coming up to its operating speeds. Several other resonance combinations above the operating speed add to the chances of coincidence with the operating speed.

It is not very often that a complete foundation analysis can be made, and the structure frequently is so complicated as to preclude exact analysis. Experience has shown that lateral and vertical vibrations can be treated independently, on which basis it is possible to construct a dynamical model of the system.

The art of measuring vibration has progressed enormously in recent years, and the problem of making reliable observations no longer presents real difficulties. One type of observation which is easily made and which is very useful involves resonance curves giving the relation between frequency and amplitude at different points for different directions of motion.

The Starting Period—Most mishaps with large turbines, such as heavy rubs, occur during the starting period, when the temperatures are readjusted from room temperatures to operating temperatures. The use of the turning gear for rolling the spindle at slow speed until the temperatures are stationary and the distortions gone is now general for large units. The eccentricities and distortions are checked carefully before the turbine is allowed to run up to high speeds. A program of instrument development has recently been completed whereby it is now possible to obtain a graphical record of: (a) The eccentricity of the shaft at various points; (b) the axial setting of the spindle; (c) the expansion of the pedestals and cylinders; (d) the vibrations of various points of the turbine structure. In addition, a noise-measuring device enables the operator to listen for rubs in various parts of the turbine through a head phone.

Bearings and Lubrication—At the present time only bearings under extraordinarily high loads are made longer than the diameter; many bearings where the length is 80 per cent and less of the diameter are in successful operation. Journal speeds are up to the order of 150 ft. per second and the pressures on projected area to well above 200 lb. per square inch without operating troubles that can be traced to these high values. With these high pressures it has gradually become desirable, and in some cases necessary, to lift the journals with high-pressure oil at starting.

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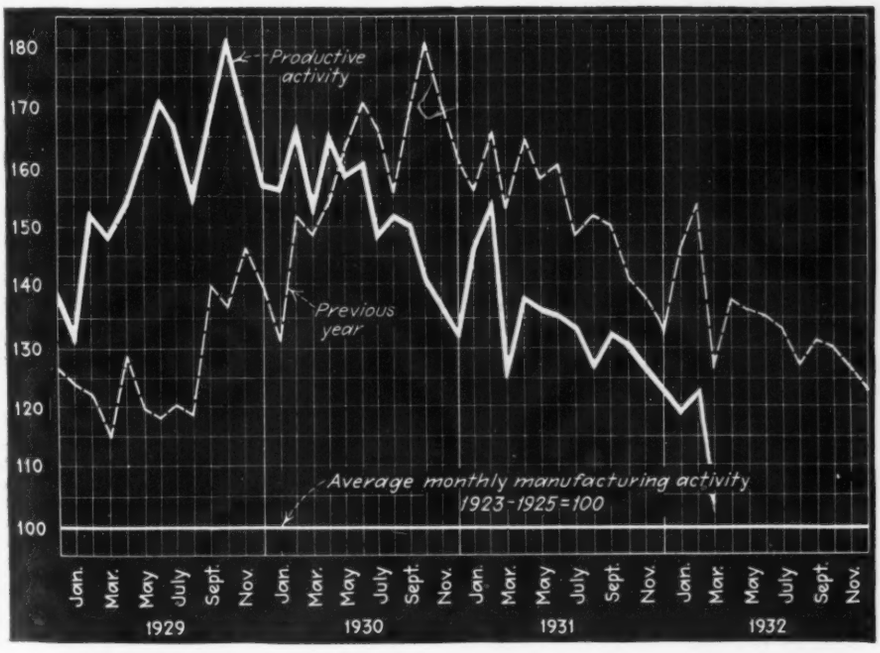
Electrical Manufacturing Sags



Monthly Index of Electrical Manufacturing Activity

Adjusted to 26 working days

Base: Average Month, 1923-1925

Month	1929	1930	1931	1932
January	131.3	156.2	146.6	120.0
February	151.8	165.2	154.3	122.2
March	148.3	153.0	126.1	102.9
April	154.6	164.9	138.1	.....
May	163.5	158.0	136.7	.....
June	170.5	160.2	135.2	.....
July	166.6	148.5	133.4	.....
August	155.4	152.2	126.9	.....
September	168.8	150.0	132.6	.....
October	180.6	140.6	130.4	.....
November	169.5	137.5	126.9	.....
December	157.0	132.4	123.5	.....

As in 1931, the average rate of activity in electrical manufacturing plants in the United States fell off in March compared with February. The decrease in the index based on reports of electrical energy consumption in these plants, as received by the ELECTRICAL WORLD, with adjustments for differences in the number of working days, was 16 per cent; last year it was larger, 18 per cent; the result is a decline, compared with March, 1931, of 18 per cent and an index slightly lower than in the early part of 1925 and much lower than at any time during the intervening period of high production.

Whether inherent in the industry or due to the manner of reporting energy consumption, it is a fact that the March index has invariably been lower than the February, during every one of the ten years for which figures are available. The decrease itself is therefore normal; its magnitude, however, is larger than the average for the preceding nine years.

The disturbing feature is the unanimity in the reduction of energy use as reported by different companies, compared with February. With a few exceptions larger and smaller concerns were similarly affected; the particular branch of electrical manufacturing seems to have made little difference in the downward movement.

Some bright spots are discernible. In the central industrial area several gains are indicated; the most significant ones are probably those of makers of industrial equipment and of certain appliances used for household purposes.

New Practices, New Tools Devised for Philadelphia Building

By W. F. McCARTER

Second Vice-President Cates & Shepard, Philadelphia

Tower houses memorial bell

The 17-ton bell, a memorial to John Wanamaker, removed from the present store building, strikes the hour and half hour by means of a solenoid-operated hammer or can be tolled independently by electrical means if desired. A microphone transmits the peal of the bell to the engineer's office, 70 ft. below sidewalk level, where it could not otherwise be heard.

PROVISION of assured power supply even in the remote possibility of failure of one of the two independent power company's cables has been made by means of a tie breaker in the new Lincoln - Liberty Building in Philadelphia. A similar arrangement has been made for the transfer of the loads of two groups of elevators to the active feeder in case there is a feeder failure for one of the groups. Automatic electrical operation of awnings, curtains and lights of the subway concourse, first floor and first mezzanine store show windows will be actuated by means of a program device to follow a predetermined schedule for each season of the year. Buses from transformer vault to switchboard are supported by slate spacers on an angle-iron frame, all inclosed by transite boxing readily removable for easy access to the conductors in case of trouble.

These are some of the distinctive features provided in this building, the lower seven floors and basements of which will be occupied by a John Wanamaker store exclusively for men. The upper floors are for rent for general office purposes.

All branch conductors are identified by a braid color code so that each phase wire and the neutral of the four-wire, three-phase distribution system can be recognized. Panelboard switch handles are also made of similarly colored material to identify the respective phases. This scheme facilitates the balancing of load at each panelboard. Red is used as the color for all wiring between the outlet and the local switch so that local runs can be distinguished from branches and mains where the various groups run together.

An interesting feature of the construction of the transformer vault is the anchoring of the floor by rods into the bedrock. The vault in the sub-basement is below the ground water level and it was found necessary to meet any possible upward thrust of water accumulating beneath the sub-basement floor. The grounding of the secondary circuit and the equipment in the vault is made by a solid copper grounding bus connected to these rock anchor rods, of which there is one for every four-foot square.

Power failure avoided by tie breaker

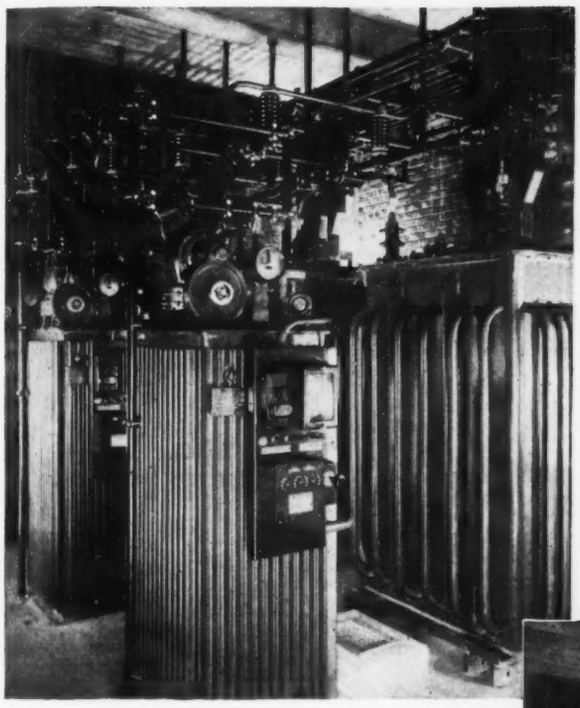
Each of the two 13-kva. feeders comes to the building from a separate substation of the Philadelphia Electric Company. Under normal operation the lighting load is served by one feeder and the power requirements from the other. Both high-tension feeders are controlled by a truck type switch. A tie breaker is provided so that both light and power loads may be served from one feeder if the other fails. Each feeder serves a bank of three 400-kva. transformers; the banks are identical in windings and taps to facilitate interchangeability.

On the switchboard interlocked circuit breakers have been provided to control the secondaries so that, while it is impossible for both banks to be connected to the same bus at one time, constant service is assured for both power and light by means of the automatic throw-over in event of failure of either bank of transformers or the high-tension feeders which serve them.

Duplicate feeders for elevators and fire pump

The idea of making current failures nearly an impossibility has been carried further in providing feeders for both the store and office building groups of elevators. This is accomplished by furnishing two feeders for the office building elevators, each of which normally carries half the office elevator load. Double-throw switches are inserted and each feeder is made large enough for it to carry temporarily the entire office building elevator load if necessary. The same arrangement has been carried out for the store section elevators.

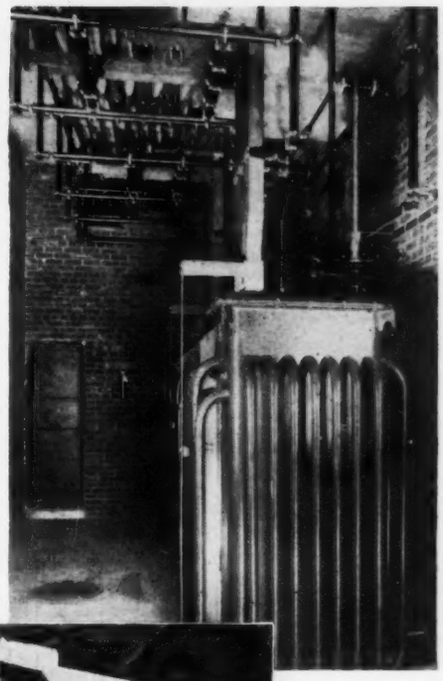
In addition to the elevator requirements, there is a total of 1,100 hp. in fans, compressors, pumps, etc., including a 200-hp. fire pump. Two feeders serve the fire pump, one from each bank of transformers. The

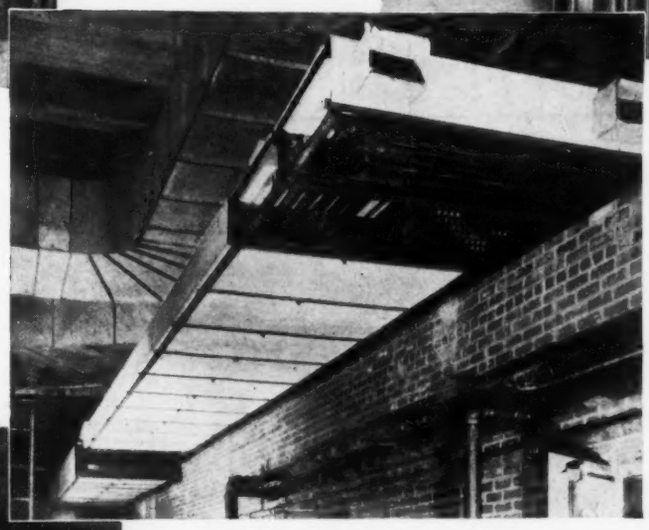


Cool ventilating air between primary regulators and transformers

Secondary bus to switchboard inclosed in transite

(Right) Bus passed through vault wall. Emergency exit door in rear. (Below) Secondary bus supported by slate spacer carried on angle-iron frame. All sections of transite inclosure removable for easy access. Air ducts above made it necessary to support duct run by rods from wall of vault. Note four bolts on all copper connections.



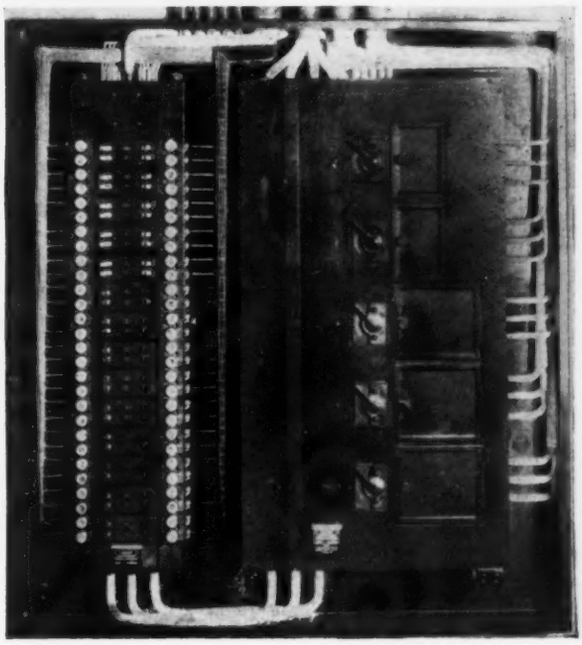


Hydraulic bender adapted to the conduit job

Thirty-ton press provided with table mounting and gages which make duplicating of bends for nesting an easy job. Same radius obtainable regardless of pipe size. No manufactured conduit elbows were used on the job.

Typical lighting panel shows compactness

All feeders and large circuit wires wrapped with asbestos tape to prevent fire spreading in case of short circuits and grounds.

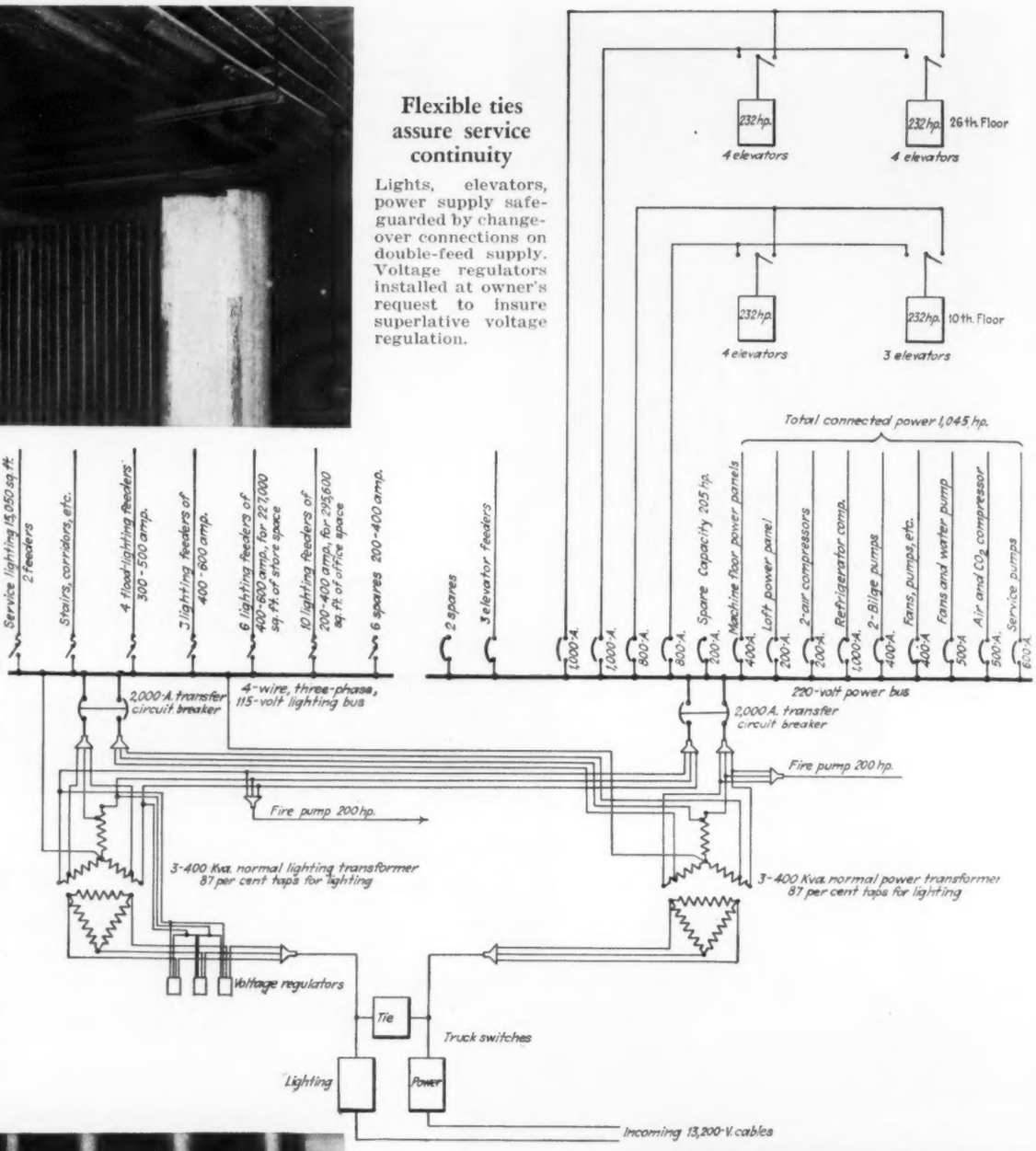


Carborundum wheel saws underfloor duct

Convenient table facilitates cutting duct without burrs.

Flexible ties assure service continuity

Lights, elevators, power supply safeguarded by change-over connections on double-feed supply. Voltage regulators installed at owner's request to insure superlative voltage regulation.

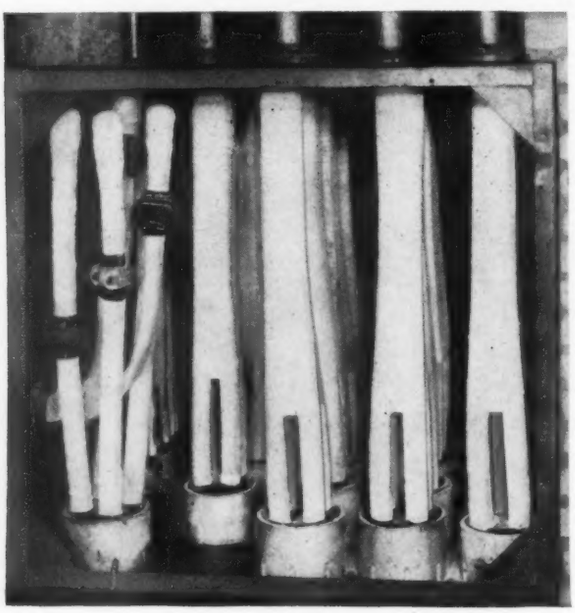


Close nesting conserves space

Vertical conduit supported by U-bolts through channel iron attached to building structure. Feeders from two separate riser shafts join here and descend to switchboard level, all in a space 12 in. wide. Conduits later bricked in with junction boxes only left exposed.

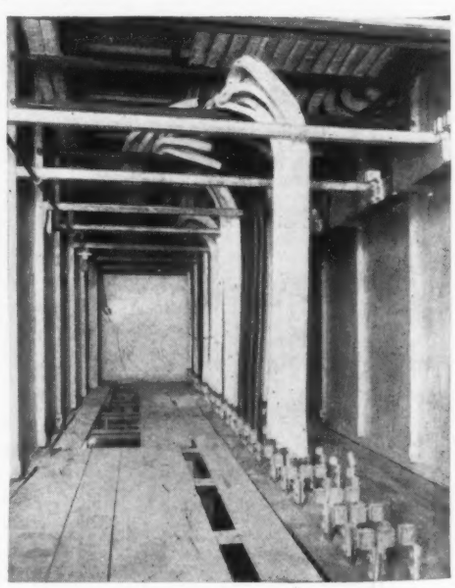
Solderless joints for cable taps

Bakelite covers on cable taps, cable support type conduit bushings, asbestos taping of all conductors are features of all junction box installations throughout the job.



Pull-box over switchboard made a large gallery

Solderless lugs tie taped conductors to bare copper bus terminals from rear of the switchboard. Permanent lighting provided in this gallery combines with ample space provisions in making access easy and convenient for changes in wiring and general maintenance. Work unfinished and temporary floor still in place.



fire pump connections are made near the secondary terminals of the transformers, thus eliminating the possibility of other load affecting the fire-pump operation.

The capacity provided in lighting feeders and panels is designed to furnish an average of 5½ watts per square foot in the store section of the building and an average of 5 watts per square foot in the office-building section. For show-window lighting on the concourse, first floor and first mezzanine floor there has been provided nearly 500 watts per lineal foot of show-window length.

Generous provision of service outlets

The office-building main areas have a total of more than 2,000 ceiling outlets, which is an average of one outlet for every 125 sq.ft. of floor space. The base receptacles in the same area total more than 1,400, or one for every 4½ ft. of wall length. In addition to these outlets fan receptacles to the number of 700 have been installed, each controlled by a local switch.

Approximately 20 miles of steel underfloor duct was installed, thus making possible the placing of floor outlets at practically any point in the floors of either the store or the office building sections. All telephone, telegraph and signal lines will be put in the underfloor duct. Clocks will be of the synchronous motor-driven type.

Conduits and cables with a capacity of 323 kw. are in place for the floodlighting of the bell tower, which forms the upper 100 ft. of the building.

By careful planning it was found possible to mount the panel boxes on the floor beams and vertical steel members in advance of the laying of the floor runs of conduit, so that the use of nipples was entirely avoided, each pipe thus being brought directly to the knockout in the previously mounted panel box.

The building was erected for John Wanamaker, Philadelphia, according to the design of John T. Windrim, architect, and Isaac Hathaway Francis, consulting engineer. The general contractor was the John N. Gill Construction Company and the electrical contractors were Cates & Shepard of Philadelphia.

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What Kind of Interlocks Are Desirable?

Twenty-two applications for interlocking systems were presented on page 538 of the March 19 issue of ELECTRICAL WORLD which represent composite usages of a variety of companies. These applications were made to safeguard life or continuity of service or both. But there is considerable difference of opinion as to how far interlocking should be carried and what schemes are advisable, as indicated by the following comments from engineers of two very large utility systems. One engineer says:

"We have never gone in for complicated interlocking schemes, but have preferred to keep our stations simple and clear enough so that no great amount of interlocking is necessary. For instance, if the disconnecting switches, which isolate an oil circuit breaker, are placed in such a position that the operator can clearly see whether the breaker is open or closed, we feel there is very little need of interlocks.

"However, we have made considerable use of a scheme which is intended primarily to require at least two different individuals to check each other before disconnecting switches are operated. This has been accomplished by the use of individual keys which unlock the compartment doors, permitting access to disconnecting switches. These keys are controlled by the operator in charge and are generally kept on hooks on the mimic bus on the switchboard at points corresponding to the switches to which they permit access. With this scheme both the operator in charge and the assistant operator must determine what disconnecting switches are to be operated and with the proper key the assistant operator cannot gain access to the wrong disconnecting switches. This general scheme has been in successful use in a number of our plants for several years."

The other engineer says: "From the viewpoint of safety to employees, safety to equipment, guarding the service or straight economics we have never felt justified in adopting automatic and sequential schemes of safety locking using padlocks with keys or electrical interlocks with keys or relays. However, we do believe in utilizing simple mechanical linkages for interlocking the compartment door and the breaker disconnects with the breaker mechanism, but we do not place our trust in the operation of this feature.

"It is our contention that too much stress is placed upon the matter of improved operation resulting from interlocking by the designing engineer and that too much faith in the infallibility of the operation is placed upon it by substation operators. Our policy has always been to surround the operator with every trustworthy safety and checking device and especially to give him those devices which will tend to keep him mentally alert. Our position is that proper education of operators is of greater importance.

"We maintain that no substitute has yet been found for the personal responsibility of the men operating the substation and that the best safety devices are those which afford the greatest degree of dependable assistance in enabling the substation operator to discharge his responsibility.

"In considering the 22 various uses for interlocking systems outlined by you,* I can think of cases where we have used only those numbered 1, 4, 11, 12 and 20. In all of these cases our interlocks are very simple mechanical schemes which many operating men know and because of their simplicity they are reliable and almost infallible in their operation.

"The most interesting proposition I have seen on interlocking is being developed by R. L. Kirk of the Duquesne Light Company, Pittsburgh, his contribution extending only to models at this time and awaiting patent rights. The reason we like these devices is that they can be fitted into our program of continual training, coaching and education of operating men. This we believe to be the secret of successful performance and this policy is borne out by our safety records and operating error records."

**Page 538, March 19, 1932, "Electrical World."*

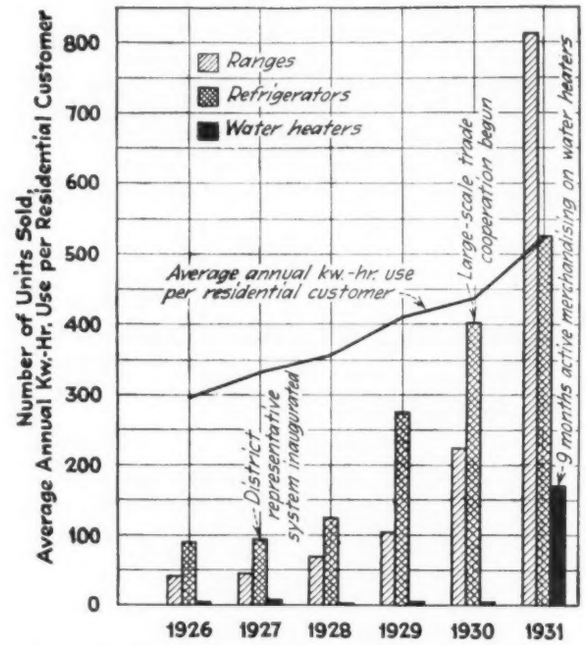
Selling 1,500 Major Appliances at Brockton in a Depression Year

Trade co-operation overcomes obstacles.

District representatives of utility aid salespeople.

Low initial and operating costs attract business in "hard times."

A SHINING exception to the dull story of depression inhibitions which has become familiar to most of us is afforded by the Edison Electric Illuminating Company of Brockton, Mass. Despite the fact that the community it serves has no more than average resources and its industrial diversity is sub-average compared with many districts of similar population totals, yet 810 electric ranges, 525 electric refrigerators and 172 electric water heaters were sold last year by the company and local retailers. The total population of the territory was 106,065 and the number of residence customers 25,662. The company is under the management of the Stone & Webster Service Corporation, which has for some time devoted much attention to the development of heavy-duty domestic appliance sales and service, to co-operation with customers through the district representative system and to working with other retailers on a mutually profitable basis.



Major appliance sales respond to co-operative cultivation of market at Brockton

Background of sales development

In reviewing the commercial progress of the Brockton company with W. E. McCreery, its resident sales manager, the point was brought out that the underlying preparation for the recent results dates back to 1927, when the district representative system of customer contacts was established. This system builds good-will and popular confidence, merchandising stimulation being of secondary importance but none the less valuable. In the four years beginning with 1927 a popular interest was gradually developed in electric cooking and in refrigeration and the decision was reached by the company to start more effective merchandising in 1931. Promotional rates had been established and near the close of 1930 a free-wiring program for ranges had been developed.

"In January, 1931," said Mr. McCreery, "we obtained a popular-priced electric range and the dealers with whom we discussed the campaign also picked out a similar product for their retail stocks. Before the first major drive began for sales we announced for the first time a controlled or off-peak rate for water-heating service and included the water heater in our merchandise. Local dealers were solicited by us to co-operate in the sales work and about a dozen took part. A three days' cooking school was held by the company in February, 1931, well in advance of the concentrated drive which opened in March. A kilowatt-hour "tournament" was a feature of the spring campaign, which ran eleven weeks, resulting in sales totaling 200 per cent of the established quotas. Points were awarded to employees selling appliances or co-operating with tips on an indoor-golf-match basis which heightened interest. Dealers and wiring contractors joined heartily in this drive and profited from both appliance merchandising and wiring.

"The fall campaign ran from September 21 to November 14. During the summer the momentum of the spring campaign enabled the usual summer sales quotas to be surpassed. Another cooking school was held and dealers and company synchronized on displays. Pre-campaign periods were utilized also in training men and in sales classes. Utility salespeople were compensated for sales on the basis of added load rather than dollar values of merchandise. In March a local refrigeration bureau was formed in co-operation with the N.E.L.A. campaign, including all dealers in this specialty. This bureau raised a total newspaper budget of $1,200, which was used in monthly co-operative advertising. In May the Brockton Electric Club, composed of all branches of the local

Table I—Comparison of Major Appliance Sales Brockton Area

	1931	1930	Per Cent Gain
Ranges	810	225	260
Refrigerators	525	400	31.2
Water heaters	172	2	.....
Totals	1,507	627	140.3 (avg.)

Company and Dealer Proportions of 1931 Unit Sales

	Company	Dealers	Dealers' Per Cent of Total
Ranges	601	209	24.5
Refrigerators	300	225	42.8
Water heaters	166	6	3.5
Totals	1,067	440	28.1 (avg.)

Table II—Per Cent of Brockton Edison Customers Using Major Appliances

	Number in Use 1/1/32	Per Cent of Total Home Customers	Per Cent of 1931 Sales to Total Now Installed
Ranges	1,350	5.27	60
Refrigerators	3,000	11.7	17.5
Water heaters	200	0.78	86

Per Cent of Company Employees Using Major Appliances

	Number in Use	Per Cent of Total Employees*
Ranges	107	40
Refrigerators	137	50.7
Water heaters	15	4.14

*If deductions were made of employees not having families or places of residence, these percentages would be greater. Practically every second employee has an electric range and an electric refrigerator.

Table III—Number and Class of Electrical Appliance Dealers in Brockton Edison Territory

	Number	Selling Major Appliances
Wiring contractors†	73	20
Specialty shops	7	7
Radio shops	15	0
Furniture and hardware	24	3
Chain, drug and department stores	12	1
Jewelry stores	4	20
Total dealers	135	31

†52 of these have no stores.

industry, was organized. These included specialty dealers, contractor-dealers, jobbers, manufacturers and utilities (another Stone & Webster property, the Electric Light & Power Company of Abington and Rockland, and co-operating dealers shared in this club's work and also achieved a sales record in heavy-duty appliances). The monthly club meetings during the year 1931 were featured by educational and social programs and were well attended.

"This club conducted its first sales activity in October, with a campaign on commercial lighting units, more than 200 being sold and installed. All merchandise and wiring profits of this sale went to the dealers. Installment accounts were financed by the company without additional charge to the dealers. To date the club's membership embraces 90 per cent of the eligible organizations.

Co-operative dealer policies used

"In order to stimulate greater sales activity the company offered liberal co-operative policies to dealers throughout the year, permitting them equal advantages in the sale and installation of their equipment. The principal features were the financing of installment accounts (applicable to any make of standard quality merchandise); free wiring, consignment of company merchandise, joint advertising, assistance of the home service department in home demonstrations and assistance on service and high bill complaints. Dealers were prompt in accepting this program and expressed their approval of company policies.

"The free range wiring was capitalized from the primary feeder to the beginning of the appliance circuit inside the home, the cost of the inside wiring to the range being charged to company sales expense."

Equipment prices in 1931

The price schedules ranged from $99.50 to $225, with an average of $110 for ranges installed; $195 to $425, with an average of $290, for electric refrigerators installed, and from $159 to $200, with an average of $165, for water heaters. Eighteen to 24 months were allowed to complete payments on ranges and refrigerators and 24 to 36 months on water heaters. About 8 per cent of the units were sold for cash.

The average connected range load added was 9 kw.; refrigerator, 600 watts; water heater, 2,500 watts. Annual consumptions figured were 1,500 kw.-hr. for the average range, 600 kw.-hr. per refrigerator and 3,000 kw.-hr. per water heater.

The promotional rate which attracted most of the new business, except water heating, last year was of the two-part type, with an area charge averaging 90 cents per month and energy prices of 4 cents each for the first 50 kw.-hr., 3.5 cents each for the next 100 and 2.5 cents each for all in excess. The controlled water-heating rate embodied a minimum charge of 50 cents per month plus all energy at 1.25 cents per kilowatt-hour. The charging

Typical letters to utility on co-operative selling

After checking the amount of business that had been done in 1931, we were agreeably surprised to find that it was nearly as good a year with us as 1930.

Looking for the cause, we found it was due chiefly to the activity of your company selling electric ranges and refrigerators, making additional wiring necessary and at the same time causing the home owner to see the need of extra additional and corrective wiring needed.

It certainly has been most helpful in keeping up our spirit as well as our business volume and believe every contractor appreciates very much your fine co-operation.

F. R. Lee.

Lee Electric Company,
371 Main Street, Brockton, Mass.

We have just closed our books for 1931 and find that although last year was a so-called "depression" year, our volume of sales on major appliances has been very satisfactory. We feel that this was made possible to a great extent by the splendid co-operation given us by your company in the way of free wiring for ranges, free wiring for changeovers made necessary where major appliances were added and exceptionally fast service on running new lines in homes where our range installations had been made.

One outstanding example of the above was an instance where we did not get a range order until 10:15 a.m. in the morning, and despite the fact that it was on a Saturday, which means a half day to your linemen and there were only two wires on that particular street, the lines were run and the range in operation at 4 p.m. that same afternoon.

We wish to take this opportunity to express our appreciation of your co-operation and hope our relations will be as pleasant for a long time to come.

Roy Kellerman.

Electric Specialty Shop of Brockton
58 Main Street, Brockton, Mass.

hours were not specified, but were left to the company to apply, but these averaged nine hours at night and two hours in the early afternoon.

Financial co-operation with dealers

At no time did the company try to make money at the expense of the dealer. Three choices were the latter's in financing: (1) The dealer could have his appliance financed by the company provided the device was standard; (2) the dealer could purchase outright any appliance handled by the company for resale in his own store; (3) the dealer could turn over his "prospects" to the company for the latter to follow up, and if a sale resulted receive a commission which averaged 12.5 per cent.

Promotion of water heating

Water-heating development came along later in the year and accounts for the relatively smaller number of sales achieved in comparison with the range and refrigeration applications during the period. The company's experience shows that people are willing to buy electric water heating in considerable numbers when its cost is brought within reach. It matters little to the purchaser of this service, says L. F. Eaton, general superintendent of the company, when and how the water is heated, provided the every-day needs of the home are filled automatically, satisfactorily and at a reasonable cost. It is only the cost of operation that has prevented its wider use in the past.

"Only a limited group of our customers can afford to pay from $10 to $20 a month for hot water," said Mr. Eaton. "That is what it costs at 4 or 5 cents per kilowatt-hour. It is probably a fair statement to say that all heaters sold to operate at much above 2 cents a kilowatt-hour have set back the ultimate development of the market more than they have helped. Two cents per kilowatt-hour seems to be about the upper limit for reasonable operating cost. The real, broad market is not reached above 1.5 cents."

In ten months' effort 161 heaters were sold at Brockton, and these are using about 4 per cent of the total annual residential consumption, pushing up the average annual home use 20 kw.-hr. The introduction of the new service was announced by a circular letter to the 75 per cent of the residential customers who are on the promotional rate and by newspaper advertising. The immediate response was a real surprise. "We did not go after the wealthy homes," said Mr. Eaton. "A majority of our heaters are in homes of moderate means. For that reason our figures showing kilowatt-hour consumption and average bills are somewhat below those of other companies. The fact that it was possible to sell a broad market has interested us more from the standpoint of future promotional effort than had most of the first year's sales been restricted to people of means. We can feel that the home owners to whom 800 ranges were sold last year are also logical prospects for economical water heating.

"About 75 per cent of the water heaters were installed with an electric range. More than half of our installations are connected to operate in series with other heaters. The average monthly bills of customers using electric heating without preheating range for this service from $3.32 with two in the family to $5.04 with five. The heaters were sold by the district representatives, floor salesmen and specialty men who were on call while working at large in the whole territory. Our prices last year were $159 and $179 cash for the 30-gal. and 60-gal. heaters, installed. On terms they were $162.50 and $184, $10 down and the balance in 24 to 36 months. This season (1932) we are offering "Everdur" 50-gal. heaters for $189.50 and $196.50 completely installed, with a slight increase for terms. The change to "Everdur" construction and a minimum size of 50 gal. has materially strengthened our position this year from an operating standpoint. . . . It is our belief that for several years, until electric water heating attains a public acceptance comparable to refrigeration and in an increasing measure to electric cooking, the utility must accept the burden of pioneering this new appliance."

23.34 per home customer

Mr. McCreery states that in 1931 the gross merchandise sales in the territory were $600,000, of which 57.5 per cent was by dealers outside the company. Appliance wiring installations brought $85,000 more to the contractors. Total appliance sales averaged $23.34 per home customer. The estimated annual energy use of the total 1931 major appliance sales is equivalent to an increase of 79 kw.-hr. per home customer. The average kilowatt-hour use per home customer for 1931 was 520 kw.-hr. Five years ago it was 331 kw.-hr. The average revenue per residential customer increased in five years from $25.74 to $30.16 and from 1930 to 1931 it gained $2.61. The average twelve-month unit rate is now 5.41 cents per kilowatt-hour.

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Gearless Clock Motor Based on Vernier Cascade

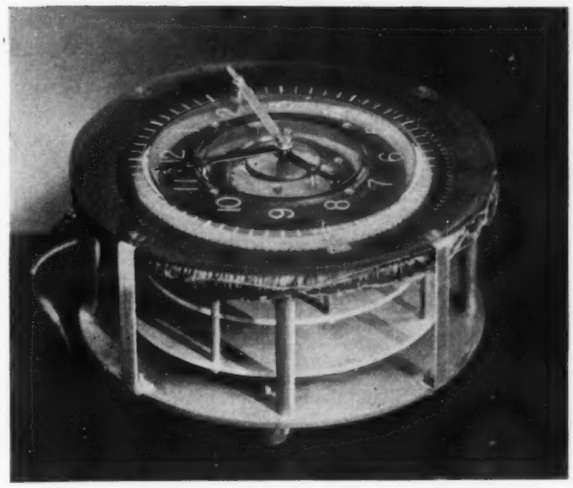
By T. R. WATTS

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

For electrical clocks, timing devices and cycle counters it is desirable to obtain a low-speed mechanical rotation from a high-speed rotating magnetic field. A new subsynchronous motor, called a "Vernier," has been invented by L. W. Chubb, director Westinghouse Research Laboratories. This motor accomplishes large speed reductions magnetically by numbers of teeth on a stator and rotor differing only by a few teeth. By making one rotor in the form of a thin ring the flux can be worked through it to a second rotor in which a further large speed reduction can be accomplished. By varying the relative numbers of teeth on the stators and rotors almost any desired speed reduction can be secured.

The new type of motor is known as the "vernier." In general, it may be said that the rotors of such motors will progress only two teeth per cycle; thus, by proper selection of the number of teeth almost any desired speed can be obtained.

The rotating magnetic field for such devices can be produced either by alternating-current windings, as in the conventional polyphase or split-phase motors, or else by means of a permanent magnet or electromagnet rotated mechanically. In the latter case a number of iron



Two revolutions per day

The same fundamental induction motor principle which appears in rayon motors of 10,000 revolutions per minute at 180 cycles is here applied for 60-cycle service to drive the hour hand at two revolutions per day in a gearless but not toothless clock.

pins set in a non-magnetic supporting ring serve as stator teeth.

The principles of the "Vernier" motor have been embodied in a gearless electric clock which includes the various types of "vernier" motors. In this clock the outer laminated stator S_1 is wound with a two-pole, single-phase ring winding excited from 60 cycles, single phase, by means of a condenser and resistor for phase splitting. The stator S_1 has 118 teeth, while the first rotor, R_1, has 120 teeth around its outer periphery. It will now be seen that there will be coincidence between the stator and rotor teeth at one diameter, while at the perpendicular diameter the stator teeth will be over the rotor slots. The rotating magnetic flux tends to go diametrically across the stator S_1 at the point of minimum reluctance, but it is obvious that when the flux rotates at 45 deg. the rotor R_1 will only move one-fourth tooth pitch to move the reluctance path 45 deg. Thus, for each revolution of the magnetic field (one cycle) the rotor moves only a distance of two teeth. The general formula for the speed of the rotor is:

$$\text{Rotor r.p.m.} = \frac{T_r - T_s}{T_r} \times \text{r.p.m. of magnetic field,}$$

in which T_r = number of rotor teeth and T_s = number of stator teeth. $T_r - T_s$ = the number of poles of the stator winding. In this case, considering the first stator and rotor:

$$\frac{120 - 118}{120} \times 3{,}600 = 60 \text{ r.p.m.}$$

The first rotor, R_1, is a solid iron ring offering considerable reluctance around its periphery, so that the flux tends to go directly through it to the laminated second rotor, R_2. Thus this first rotor, R_1, having 122 teeth around its inner circumference serves as a stator for the second rotor, R_2, which has 120 teeth. Therefore the speed of the second rotor, R_2, with respect to its stator, R_1, is:

$$\frac{120 - 122}{120} \times (3{,}600 - 60) = \frac{-2}{120} \times 3{,}540 = 59 \text{ r.p.m.}$$

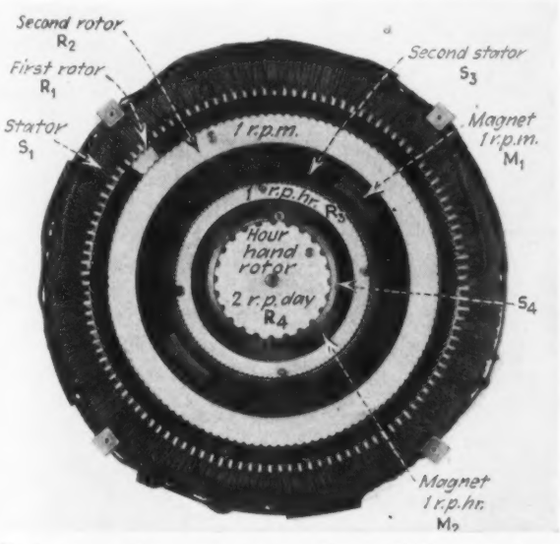
Therefore R_2 runs backward 59 r.p.m., with respect to R_1, which is running forward 60 r.p.m., making the net speed of R_2 = 1 r.p.m. forward. The rotor R_2 drives the sweep second-hand and also carries the permanent magnet M_1, which rotates around a micarta ring, S_3, in which are set 118 iron pins (not visible in the picture), which serve as a 118-tooth (second) stator. The rotor R_3 has 120 teeth and runs one revolution per hour, carrying the minute hand of the clock. Similarly, it carries a second permanent magnet, M_2, which rotates about a brass ring, S_4, in which are 22 iron teeth, serving as a stator for a 24-tooth rotor, R_4, which runs one revolution in twelve hours and carries the hour hand of the clock.

Thus, we have embodied the "vernier" motor and also the "vernier cascade," consisting of two rotors driven by the same rotating magnetic field. The minute hand and hour hand driven by the permanent magnets embody the principles of a combined magnetic clutch and speed-reduction gear.

It is apparent that the principles used in the outer stator and rotor are also useful for a frequency changer because if the first rotor has a secondary winding the frequency in the secondary will be equal to the frequency in the primary minus the speed of the secondary rotor.

Devices utilizing these principles will be developed, since the mechanism has obvious advantages for various timing and light-load applications requiring low-speed synchronized, silent drives. One great advantage, as contrasted with the ordinary well-known cheap sub-synchronous clock motors having equal pitch of stator and rotor teeth, is that the Vernier motor has a torque which is smooth and uniform throughout each revolution of the rotor and requires no flywheel effect.

The experimental model was not deliberately designed or even expected to be self-starting. However, with proper design the first rotor could be made self-starting by means of its own hysteresis and eddy currents, or else with the assistance of a squirrel-cage winding. It is only necessary to start the first rotor as the speeds of the other rotors are so low that they fall into step without any special means being provided for starting.



Each rotor advances two teeth per field revolution

Utility Public Relations

By A. L. BILLINGSLEY*
President Fuller & Smith & Ross, Inc.

Maintenance of constructive dissatisfaction desirable.
Customer relations should be positive sales relations.
Not a separate department.

YOU can't separate your customer relations problems from the very practical conditions that give rise to them. One of these conditions is that if you're going to get more business, if you're out aggressively to build load and increase current consumption by the most aggressive methods, you're going to create a set of customer relations problems by that very act.

You can't, for instance, use high-pressure selling methods and not have somebody resent it. You can't turn salesmen loose on commission and pound them to get business, and expect them of their own accord to be always judicious in whom they approach, perfect gentlemen in forcing themselves inside the front door, modest in all the claims they make for their product, considerate of their competitors, and genuinely concerned with the best interests of the housewife and her family. You can't aggressively campaign one manufacturer's product and have dealers of competing products love you for it. You can't tell meter readers to sell appliances and not have them get on somebody's nerves.

I only use selling as one illustration of the situation. The same thing applies to every other commercial policy. The particular practice you follow in charging for your current—and the rates you charge—create a set of customer relations problems peculiar to your practice. So does your policy in seeking franchises—so does your attitude on political and public questions. You can't separate customer relations problems from your commercial and managerial policies.

I bring this out because I think I detect at times a feeling among utility men that good customer relations are something you can set apart and consider separately from other things—a feeling that you either have good customer relations or you don't have them; that not having them you can set about creating them independently of your other activities; that when you have created them, you have something that you own and can expect to keep more or less permanently.

That, I believe, is a purely theoretical view of customer relations. Customer relations are something you build while you are building something else. They are something that does not exist apart. You never have them in the same form permanently—they change with each evolving expression of your commercial work. They are good or bad, as you are able successfully to do the things which you desire to do commercially.

Such being the case, it is necessary that utilities face frankly the effects that their commercial policies and their commercial desires may be expected to have upon the feelings and attitudes of their customers. It is necessary that a technique be constantly in operation that will offset any of the bad effects—strengthen the good ones.

One of the first requirements of such a technique, it seems to me, is to have a clear picture of every policy, to know what its effects on customers may be, to recognize the dangers and to set into motion the proper correctives.

I have often felt that one of the reasons utilities meet unexpected states of mind among customers is because their policies are not clearly known throughout their own organizations, and are not always thought through at the source. I think there is a place in utility operations for published policies and for printed codes of practice. We have had much experience with codes and formally expressed policies in other industries. While they are open to some objections, they do have the advantage of making the management think through definitely on a policy, of going on record concerning it, of considering in advance all the effects it may have. Code statements promote the setting up of arrangements for offsetting any unfavorable effects on public and customer relations. They bespeak sincerity. Above all, they automatically help to educate the entire organization and make it a unit. I would recommend the consideration of published policies and codes as one of the basic steps in any program for building and improving customer relations.

A second requirement in customer relations technique is to have the right attitude toward complaints. Complaints are the expressed measure of the effects on the public of your performance and your policies. But because the very sound of the word "complaint" is unfavorable, I think there is a tendency for utilities to place too much emphasis on the numbers of complaints that may exist and to try to keep the number down. I do not favor any program which deliberately provokes complaints or which deliberately sets an organization to seeking them, but if I were managing the commercial activities of a public utility I would want to be sure my organization understood that my attitude was not one of trying to keep the total number of complaints down.

You want to know what reaction your commercial policies are having on customers, and the only way to find out is to observe your customers. Complaints are your most definite source of reaction. Accordingly, you

The gentle art of aggressive selling is a process of creating dissatisfaction — of making people desire something they don't now have — of making them unhappy till they have it — of persuading them to pay a price for it in terms of sacrifice and effort. Creating dissatisfaction is in itself contradictory to the basis of good customer relations — which is tranquillity, peace, complete satisfaction with things as they are.

**Abstract of address before Commercial Section, Pennsylvania Electric Association.*

should receive them, study them, learn from them, be guided by them. Above all, you should have a clear procedure for handling them and for giving satisfaction. You should train your people so that they do not take pride so much in a small number of complaints as they do in the lack of significant cause for them. Complaints are to be regarded as opportunities for building goodwill, and for creating selling opportunities through interested and intelligent handling.

A third thing about a customer relations technique is not to expect too much of people. This involves a frank appreciation of the nature of the utility business and a shrewd understanding of human nature. It is not a question of whether people are right or wrong, it is a question of psychology—how people react.

For example, it is a well-known fact that people generally distrust that which they do not understand. For people to misunderstand and to fail to appreciate your service is, accordingly, normal and not abnormal. It is exactly what you can expect. You can expect to prosecute an unceasing educational job with your customers. The responsibility to have your business understood is something that rests on you, and not on your customers.

The individual wins

Another simple psychological truth is that in any conflict of interest between an individual and an institution public sympathy usually flows toward the individual. Accordingly, when a utility gets into conflict with any individual in its market you can expect public sympathy normally to flow toward the individual and not toward the utility. There just "ain't no justice" for a utility if it locks horns with an individual. In your policies you need to recognize this, and to recognize that you may have to do many things far beyond what justice calls for to have your business viewed fairly by your customers.

You make a point of saying that every individual gets the same quality of current, pays the same price for it, receives the same treatment. Yet you only need to look around to see that the average American does not want just that—he is happiest when he gets something that represents a preference over his fellows.

Other retailers take cognizance of this human trait. Maybe it is impossible to do it to the extent that other sellers do. If you can't, it is necessary to recognize frankly that you are at a disadvantage on that point. But your aim should be to shape customer relations policies so as to individualize your customers as much as possible and to play up each customer's feeling of individual importance. The red tape which utilities are all so conscious of affects customer relations adversely in that it makes the individual feel unimportant and one of the herd. Impersonal attitudes on the part of employees aggravate this condition. It is a fundamental handicap which you must recognize and offset.

Worries that can be obviated

Customer relations policies cannot be shaped with the ultimate hope in view that you will obviate the necessity of ever having worries about your customer relations. I think they should be shaped with a recognition that worry is incumbent upon you; that you must show the customer more clearly than you have shown him in the past that you feel your life is in his hands; that you recognize that you must satisfy him; that you are concerned with the possibility of not having satisfied him. That is simply good common sense as well as sound psychology . . . and it's necessary.

You might say your business would be all right if it weren't for the peculiar ideas of your customers. However, I am sure you will remember that the old Quaker who said, "Everybody is peculiar but thee and me," said it with a smile.

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How Much Light Does the User Want?

By M. LUCKIESH

Director Lighting Research Laboratory, General Electric Company, Cleveland, Ohio

Even though our eyes evolved through countless centuries under thousands of foot-candles outdoors, we often hear the expression "too much light" directed against our comparatively low intensities of artificial light. Notwithstanding the obvious error of such a contention, it is desirable to accumulate data from many angles to counteract this idea.

A series of experiments was conducted to determine the intensity of illumination which persons would choose as the most satisfactory for continued use in reading. Each person was asked to choose by actual trial the intensity which seemed comfortable and desirable for reading and not an intensity with which it was just possible to get along. Twenty-four persons were individually tested under good lighting conditions. The amount of light available could be varied from practically zero up to a given maximum. The tests were repeated on four different occasions for each person, but, unknown to the observers, the maximum available intensity in each test differed from that available previously. All maximum available intensities were in line with or considerably higher than present lighting practice. The average results for the groups tested are as follows:

	Maximum Available Intensity, Foot-Candles	Average Intensity Chosen, Foot-Candles
First test	10	6.3
Second test	30	11.8
Third test	45	16.9
Fourth test	100	32.0

It is interesting to speculate why they did not choose the maximum in each case. However, it is important that, step by step, each time more light was available more was considered desirable and comfortable for continued reading. Tests of this character and installational evidence gained from lighting installations in factories, offices, theaters, hotels, etc., could warrant the statement, the user has an insatiable appetite for light. Assuming all lighting conditions properly cared for in design, it is difficult to predict the future levels of illumination in many fields. There are many other facts pointing toward higher levels, but these tests alone indicate that the user's own choice is for higher levels of illumination.

READERS' FORUM

Reducing Radio Interference from Transmission Lines

To the Editor of the ELECTRICAL WORLD:

On page 199 of the January 23, 1932, issue of the ELECTRICAL WORLD an article entitled "Reducing Transmission Line Radio Interference" appears, upon which I should like to offer the following comments:

In the first place, the voltage scale in the figure is apparently wrong, 15,000 and 20,000 probably being intended instead of 1,500 and 2,000 as printed. Likewise, the fact that the zero point on the voltage scale is not shown is misleading because the curve marked *"A"* might be taken to indicate that the radio interference started at zero voltage and increased as the voltage was raised. Our experience with many radio interference tests indicates that the radio interference starts at a definite voltage and increases in intensity as the voltage is raised above this critical starting voltage. Our tests have shown the interference starting voltage to be between 6 kv. and 12 kv. to ground on the various untreated 45-kv. pin type insulators.

The following statement appears in the article: "If an ordinary insulator is coated on top with aluminum paint the interference will be cut down very materially. This is due to the fact that the tie and line wires make good contact with each other and the top of the insulator through the metallic paint."

Our experience with the usual kinds of aluminum paint indicates that the paint is a very good insulator. However, a conducting aluminum paint can be prepared by treating the aluminum powder with acid to remove the aluminum oxide immediately prior to mixing the paint. Likewise, the vehicle used in the paint must be of amyl-acetate-acetone variety rather than varnish or oil or the resulting paint will be a non-conductor of electric current. The paint also must be applied promptly after its preparation or its conductivity will be greatly impaired.

Prof. F. O. McMillan of Oregon State College, as a result of his investigations conducted for the N.E.L.A., has reported as follows:

> The primary cause of radio interference from pin type insulators was found to be ionization of the air in thin air gaps in series with thick porcelain sections in regions of strong electric field. This condition is generally found in three different places on the usual design of multi-shell pin type insulators as follows:
>
> 1. At points where the conductor and tie wire are not in intimate contact with the head of the insulator.
> 2. At points of imperfect contact between the pin or thimble and the pin hole.
> 3. Between shells of multi-part insulators.
>
> There are three rather obvious methods of attack to eliminate these troubles:
>
> 1. Design the insulator in such a manner that there are no regions of overstressed air.
> 2. Provide a conducting coating to act as a dielectric flux distributor at the head, in the pin hole and at necessary points between the shells.
> 3. Displace the overstressed air with an insulating compound sufficiently strong dielectrically to withstand the potential.

In view of the above findings in the Oregon State College laboratory and the fact that the usual aluminum paints are non-conducting, it seems probable that the reduction in interference observed on insulators treated with aluminum paint was due to the paint, an insulating compound displacing overstressed air rather than acting as a dielectric flux distributor or improving the contact to the tie wire.

In the last paragraph of the article a test apparatus is described in which "a milliammeter in the loud-speaker circuit" is specified. This statement might be construed to mean that a milliammeter, either a.c. or d.c., should be connected in series with the loud speaker. With some loud speaker connections and an a.c. milliammeter such a connection would work, but in the general case some sort of an alternating-current voltmeter fed through a transformer or in series with a condenser and measuring the voltage across the loud speaker would be used to give a reading which is a function of the sound output from the loud speaker.

FRED B. DOOLITTLE,
Radio Engineer.
Southern California Edison Company, Ltd.,
Los Angeles, Calif.

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BOOK REVIEWS

Behemoth. The Story of Power

By Eric Hodgins and F. A. Magoun. Doubleday Doran & Company, Inc., New York. 353 pages, illustrated. Price, $3.50.

This is a romance of the machine age experimenters. With dash, vigor and enthusiasm the authors tell about the early days of the engine, the locomotive, the motor, the cable and other machine developments. They have made a thorough research to get dates and facts accurately and then personalize and humanize these inert items to give a glowing account of the men and their difficulties in developing their conceptions. The book is focussed upon those who worked with their hands as practical engineers and omits consideration of Maxwell, Carnot and the other theorists.

For accuracy, style and a co-ordinated treatment of the basic developments in the experimental era the book is unique. It is written for popular reading, yet belongs in the library of every technical man and engineer.

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General Engineering Handbook

By C. E. O'Rourke. McGraw-Hill Book Company, New York. 883 pages, illustrated. Price, $4.

This composite work affords a convenient compilation of the most pertinent subject matter of three branches of engineering—civil, electrical, mechanical—in such form that a member of any branch can readily find what is most likely to concern him in the two others. There are sections on mathematics, tabular data, mechanics and engineering materials, structures, surveying, railways, highways, steam and water power, machinery, and welding. The electrical matter represents about one-sixth of the total.

Men of the Industry

Edwin Gruhl Elected President of North American Company

Following the annual meeting of stockholders of the North American Company on April 25 the directors elected Frank L. Dame chairman of the board

Edwin Gruhl

and Edwin Gruhl president. Mr. Dame has been president of the North American Company since 1921 and during the same period Mr. Gruhl has been vice-president and general manager of the company.

Mr. Gruhl was born in Milwaukee in 1886 and was graduated from the University of Wisconsin in 1908. He was identified with the early work of the first state system of public utility regulation in Wisconsin, originally as a member of the Wisconsin Railroad Commission's engineering department and later in charge of its statistical and research department. In 1911-12 he was special lecturer in public utility economics at the University of Wisconsin. In 1912 he became assistant to the vice-president of the North American Company, in 1914 assistant to the president, in 1920 vice-president and in 1921 vice-president and general manager. Mr. Gruhl has also been president of the North American Edison Company, the principal subsidiary, since its organization in 1922. For a number of years he has been active in the National Electric Light Association, having served as a vice-president since 1929. In addition, at the present time he is serving as a member of the constitution and by-laws committee, finance committee and the public policy committee. In commenting on the election of Mr. Gruhl, Mr. Dame said:

"As vice-president and general manager Mr. Gruhl has been a joint executive head of the company throughout my term as president and he now receives the title of the position which in practical service he has shared with me. The changed titles, which were suggested on my own initiative, more correctly represent the relationship we have developed together in carrying out the company's established policies. In assuming the chairmanship of the board, I am not curtailing my active service with the North American Company and shall continue to serve in a full-time capacity in the same co-operation with Mr. Gruhl as in the past."

Frank L. Dame was born in Boston in 1867 and after graduating with a degree in electrical engineering from Massachusetts Institute of Technology in 1889 joined the Westinghouse Electric Company. He was engaged at first in construction work and began the operation of public utilities in Vancouver, B. C., in 1890. For many years Mr. Dame supervised utility operations of companies in various parts of the United States formerly controlled by the General Electric Company. In 1920 he became vice-president of the North

Frank L. Dame

American Company and in 1921 president. He has also been chairman of the board of the North American Edison Company, the principal subsidiary, since its organization in 1922.

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CLIFFORD L. HARROD, president of the Indianapolis Power & Light Company, has been appointed chairman of the national affairs committee of the Indianapolis Chamber of Commerce.

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JOHN E. ZIMMERMANN has been elected a director of the Pennsylvania Railroad Company to succeed Charles E. Ingersoll, resigned. Mr. Zimmermann is president of the United Gas Improvement Company, chairman of the board of the Philadelphia Electric Company and a director in various corporations.

Commercial Personnel of New York Utilities Reorganized

Following the appointment of Joseph F. Becker to the position of vice-president in charge of sales of the New York Edison Company and the United Electric Light & Power Company and of Clarence L. Law as general commercial manager for both companies, a reorganized set-up was announced for the commercial activities of the two companies. C. K. Nichols, formerly manager of the industrial sales bureau, is now commercial manager of the Edison company, Manhattan; J. N. Musso, formerly manager of the Tremont district office, is now commercial manager of the Edison company, Bronx, and A. F. Berry, formerly assistant sales manager of the United company, is now commercial manager, United. C. R. Skinner, Jr., formerly chief of the electric automobile division, is now manager of the industrial sales bureau, succeeding C. K. Nichols.

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RALPH H. GIBSON has been appointed manager of the Rockville, Conn., district of the Rockville-Willimantic Lighting Company.

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E. H. WILL, formerly manager of the Virginia Electric & Power Company in Suffolk, has recently been transferred to the Richmond office of the company. I. Reid Carlisle has been appointed to suceed Mr. Will in Suffolk.

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E. G. CAHILL, of the Cahill Brothers, San Francisco contractors, has been appointed manager of the San Francisco Public Utilities by the Public Utilities Commission of that city. The Hetch Hetchy system, the Municipal Railway, the Water Department and the municipal airport will be under the management of Mr. Cahill, who is a mining engineer.

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RICHARD H. MCKAY, electrical engineer for the Washington Water Power Company and chairman of the Associated Engineers of Spokane, has been appointed district manager for the power company at Cœur d'Alene, Idaho, succeeding J. W. Voellmeck, resigned. Mr. McKay has been in the company's engineering department since 1921.

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JOHN C. PARKER, president of the Brooklyn Edison Company, has been elected as the representative of the electric light and power group on the board of directors of the American Standards Association. He succeeds M. S. Sloan, whose term expired in December, 1931. Mr. Parker has been a member of the American Standards Association Standards Council representing the American Institute of Electrical Engineers for

several years, and was vice-chairman of the council for the year 1931 and until his resignation in March, 1932. He has also been a member of the association's committees on representation and on procedure.

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A. C. Joy, manager of the publicity department of the Pacific Gas & Electric Company, San Francisco, is the new president of the San Francisco Electrical Development League.

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Sidney Hosmer has been appointed general manager of the Edison Electric Illuminating Company of Boston, following the recent death of C. L. Edgar, who held the title of president and general manager for many years. A biographical sketch of Mr. Hosmer was published in the Electrical World January 9, 1932, page 113, at the time of his being named vice-president and assistant general manager of the company. Mr. Hosmer has been in the central-station field at Boston since 1894 and for 30 years was superintendent of the Boston Edison company's construction bureau. He will retain his vice-presidency in his further connection.

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Howard J. Butler, manager of the Citizens Power & Light Company, Council Bluffs, Iowa, for seven years, has resigned. Mr. Butler's resignation was the result of ill health and he expects to take a long respite from his duties before engaging actively in business.

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E. W. Morris, formerly identified with the Los Angeles office of the Westinghouse Electric & Manufacturing Company in the capacity of general engineer, is now with the San Francisco office in the capacity of industrial application engineer.

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Earl J. Good, formerly division sales supervisor for the Public Service Company of Indiana, has been appointed district manager for the company with offices at Lebanon. Mr. Good has been with the company at Lafayette, Ind., since 1920, first as an assistant engineer and later as engineer. In 1922 he was transferred to the sales department. He graduated from Purdue University in 1917.

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William Buchsbaum, who has been identified with the public utility industry for more than 30 years, has been elected a vice-president of the Associated Gas & Electric Company and will be connected with the financial management of the company's system. He has been a director of the company for the last three years. Mr. Buchsbaum first was associated with the Public Service Corporation of New Jersey, later joining the New York Edison Company, and after several years becoming an officer of W. S. Barstow & Company. He was a director and financial vice-president of the General Gas & Electric Corporation prior to its acquisition by Associated.

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Joseph James Pickett, electrical and mechanical engineer, formerly vice-president and operating manager of the East Coast Utilities Company, Chicago, has been appointed senior assistant utilities engineer of the Maryland Public Service Commission, with headquarters in Baltimore. Mr. Pickett's previous connections include the Aluminum Company of America, Pittsburgh; Lee C. Moore Company, also of Pittsburgh; Sanderson & Porter, Chicago, consulting engineers, and Hagenah & Erickson, also consulting engineers of Chicago.

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C. L. Farrar, who has been serving as associate professor of electrical engineering at the University of Arkansas, Fayetteville, is now engaged in the school of electrical engineering of the University of Oklahoma, Norman, Okla.

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OBITUARY

Bartholomew J. Egan, 69, retired purchasing agent of the Nebraska Power Company, died recently at his home in Omaha. Mr. Egan was well known in the electric manufacturing industry.

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Samuel A. Chase, for more than 40 years a prominent figure in national electrical trade circles and a frequent speaker at electrical conventions, died at his home in Mansfield, Ohio, on April 12. He was 70 years old. Mr. Chase, who was originally educated for the ministry, spent his life in the electrical industry and was long associated with the Westinghouse Electric & Manufacturing Company. He was the author of several trade books and many electrical trade slogans.

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Richard S. Pattee, general attorney and secretary of the New England Power Association, died at the Deaconess Hospital, Boston, April 19, after a short illness. Mr. Pattee was born at Quincy, Mass., in 1889, was graduated from Harvard College in 1911 and from the Harvard Law School in 1915. He was associated with the law firm of Ropes, Gray, Boyden & Perkins for many years, and in 1927 became general attorney for the power association.

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St. George Lane Fox Pitt, famous British electrical pioneer, died recently in London, aged 75. Born at Malta in 1856, Fox Pitt devoted himself in early manhood to mechanical invention and scientific search. He invented the Lane-Fox system of electric lighting and distribution, taking out one of the earliest patents (1879) for the use of small incandescent lamps in parallel, was one of the first active workers in the Society for Psychical Research and was organizer of the International Moral Education Congress. He wrote a number of books on science, philosophy, education and social problems. He attempted to enter Parliament on three occasions, but without success. In a discourse at the Royal Institution in London as far back as 1912 the late Campbell Swinton said that Fox Pitt was "the first person to imagine, or at any rate to patent, a public electricity supply to all and sundry."

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Joseph D. Wardle, chief engineer of the Iowa Railway & Light Corporation, Cedar Rapids, died April 10 in his home in that city at the age of 70 after a week's illness of influenza. He had been prominent in the engineering circles of the state and in Cedar Rapids civic and community activities. Mr. Wardle was born in Lockport, Ill., in 1861 and in 1887 became a civil engineer and construction foreman. In 1900 Mr. Wardle became identified with the newly-organized Cedar Rapids & Southern Construction Company, from which the Iowa Railway & Light Corporation was organized. Mr. Wardle had been president of the Iowa section of the American Society of Civil Engineers and director of the Iowa Engineering Society.

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Charles C. Moore, 63, president of the C. C. Moore & Company Engineers, San Francisco, Western representatives for the Babcock & Wilcox Company and numerous other manufacturers of kindred equipment, died April 17, at his country home in Santa Cruz, of a cerebral hemorrhage. Mr. Moore entered the employ of the San Francisco Tool Company in 1885 as a mechanic. He succeeded to that company's business when, in 1902, it was reorganized as the C. C. Moore & Company Engineers, specializing in motor power and hydraulic work. He remained president of that company until the time of his death. He was prominently connected with local and state civic activities, being president of the Panama Pacific International Exposition in 1915 and president of the San Francisco Chamber of Commerce from 1908-09. Also he was president of the Society of California Pioneers at the time of his death. Mr. Moore's activity was devoted primarily to steam power plants for many years, and pioneering projects he built in this field are now in operation in the Far West.

Trade News

Specifications for cedar-pole butt treatment, involving the incised process, hot and cold treatment and hot treatment alone as methods of applying preservatives to cedar poles, as set forth in specifications adopted by the Western Red Cedar and the Northern White Cedar associations, have recently been published by the Naugle Pole & Tie Company and are available upon application to that company.

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C. F. Henderson and James H. Southard, manufacturers' representatives, covering central and northern California and Nevada, have announced their consolidation as the Henderson-Southard Company, with offices at 600 Call Building, San Francisco.

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Price reductions up to $100 on the largest models are announced by the Kelvinator Corporation, Detroit, on its seventeen domestic and on commercial refrigeration units.

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Active direction of the Mackintosh-Hemphill Company of Pittsburgh, a company long associated with the electric industry in the development of rolling mill machinery, has passed into the hands of Col. J. S. Ervin, who was elected president and a director. Colonel Ervin has a broad background of experience as a sales executive in the steel industry. Other changes included the election of F. Hughes Moyer as vice-president and senior engineering officer; H. E. Field, a vice-president, and F. C. T. Daniels, chief metallurgist and chief research engineer.

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Announcement has been made by the Dings Magnetic Separator Company, Milwaukee, Wis., of the appointment of J. Max Lee of Los Angeles as sales representative for the company in southern California.

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A price reduction has been announced by the Sparks-Withington Company on the entire line of Sparton electrical refrigerators. The new price is $133.

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Reliance Electric & Engineering Company, Cleveland, announces the appointment of Charles V. Fish to represent it in Allentown and northeastern Pennsylvania. His headquarters will be in Allentown.

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Combustion Engineering Corporation, New York, has available for distribution copies of an article describing the new steam generating unit recently placed in operation at the Duluth station of the Minnesota Power & Light Company. This unit embraces one of the largest single-pass, sectional-header boilers ever installed, together with an all-water-cooled furnace equipped for the horizontal firing of pulverized fuel.

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Holo-Krome Screw Corporation, Hartford, Conn., has been licensed by the Dardelet Threadlock Corporation to manufacture and sell socket-head cap screws, hollow-set screws and countersunk pipe plugs threaded with the Dardelet self-locking thread.

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Diamond Electrical Manufacturing Company, Los Angeles (an affiliate of the Square D Company), has announced that it has completed arrangements to manufacture, distribute and market a complete line of home and office chimes to be sold under the trade name of "Diamond E" electro chimes.

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Lead Industries Association announces that new standards for lead-pipe sizes and weights have been adopted by leading manufacturers. In an informative booklet on lead products recently issued the association has tabulated these new standards.

Trumbull Electric Manufacturing Company announces the transfer of F. M. Oglee, formerly representative in Chicago, to Philadelphia, to succeed F. W. Knoeppel, resigned. D. F. Laird, formerly a representative in the Detroit district, has been transferred to Chicago, to take the place of Mr. Oglee.

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Allis-Chalmers Rumley, Ltd., of Winnipeg, Manitoba, has taken out extra-provincial incorporation papers in British Columbia, and registered offices of the organization have been set up at 626 West Pender Street, Vancouver. Registration papers officially describe the company as a manufacturer of and dealer in machinery of all kinds.

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Electric Storage Battery Company has announced removal of its branch in Denver, from 1424 Wazee Street to 810 Fourteenth Street.

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A. Honeychurch, who has been repair representative for the Weston Electrical Instrument Corporation, and L. C. Tobin, who has been operating as the Jewell Laboratory, have merged to form the Pacific Electrical Instrument Laboratory, 600 Call Building, San Francisco, effective May 1. This new organization will handle all of the repair service work for both Weston Electrical Instrument Corporation and Jewell Electric Instrument Company.

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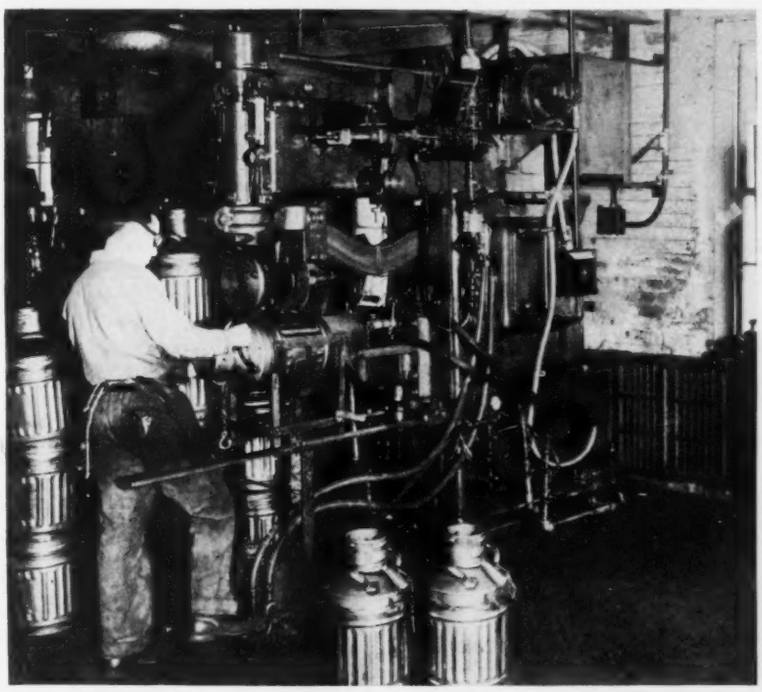
CONTROLLED WELDING MEANS UNIFORMITY



Intermittent line welding with General Electric electron-tube control is bringing uniformity of results with better welds at the plant of George D. Ellis & Sons, Inc., Philadelphia, manufacturers of milk cans. Incidental economies include a decrease in the number of cans to be rejected and a reduction in the time required for testing.

New Equipment Available

Improved Easy-Stop Push-Button Control

A feature of the new push-button switch just announced by the Lincoln Electric Company, Cleveland, Ohio, is that the start button is inside of the stop button. The stop button can be

operated from any angle by merely striking the front of the control box with the flat of the hand, but the start button must be operated with the finger. With the new push button the stop button can be locked in the off position by pushing it in and twisting it.

It is claimed the button will handle the heaviest control circuits up to 600 volts a.c. or d.c. because the contact opening is larger than usual. Contacts are inclosed in a dustproof, cold-molded asbestos case. The button is self-contained and need not be taken apart or even removed from the box cover for wiring. All of the terminals are clearly marked and brought out of the case to the back, where they are easily accessible.

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Mercury Switch Operated by Magnetic Control

A mercury switch which operates entirely by magnetic control, known as "Magnetrole," is announced by Providence Electric Controls, Inc., Providence, R. I. A gas-filled tube containing two mercury pools and a floating displacement member is placed within the field of an electric coil. When the coil is energized the floating piece within the tube is drawn down, displacing a certain amount of mercury. This causes a rise in the level of one of the mercury pools with a consequent merging of contacts. The arc takes place around the edge of a treated ceramic tube which will withstand extremely high temperatures without deterioration.

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Pyrometer Lamp to Measure Furnace Temperatures

A pyrometer lamp which measures within 5 to 10 deg. C. of the temperature of a furnace has been developed by the General Electric Company, Cleveland. The pyrometer lamp consists of a black-coated, pear-shaped bulb containing an inverted U-shaped carbon filament and a small eyelet about $\frac{1}{8}$ in. apart. These are mounted midway between two windows in the bulb and in such a manner that the center of the eyelet and horizontal portion of the filament are on a line of sight.

When measuring the temperature of a furnace the lamp is held as near the furnace door as convenient and the part to be measured is viewed through the windows of the bulb. The brightness of the filament is adjusted by varying the current through it by means of a rheostat until it matches that of the furnace, at which time the filament current is read on an ammeter.

The advantage of the eyelet is that it indicates the calibrated portion of the filament and enables the operator to keep his eye focused on the plane of the filament at the time it blends with the background.

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A NEW CURTIS WALL UNIT, known as "Dua-Light," which provides either complete indirect room illumination or a reading light or a combination of both, all from one fixture, is announced by Curtis Lighting, Inc., Chicago. Specially designed for hospitals, it eliminates the ceiling outlet and saves the expense of purchasing and providing outlet for bed lamp. It is a combination unit that seems to solve the problem of providing the effective, adequate glareless lighting so vital to convalescence.

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A REFRACTORY BRICK known as "Laclede Mullite," a stable crystalline combination of silica and alumina, is announced by Laclede-Christy Clay Products Company, St. Louis, Mo. Mullite crystals are highly refractory and their presence in any refractory material is therefore desirable. The brick is a closely woven network of "mullite" crystals. "Laclede mullite" is non-spalling. It is somewhat more resistant to temperature changes than ordinary fire brick. It is also non-shrinking, resistant to slag action and has a high load-bearing capacity.

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Circuit Breaker to Minimize Emission of Oil

A new type 0-12 circuit breaker to minimize the emission of oil is announced by the Condit Electrical Manufacturing Corporation, Boston Mass. Main current-carrying members are the Condit inverted laminated brushes, designed to withstand extremely high inrush current. Brushes are protected on opening and closing by exceptionally large arcing contacts whose thermal absorption capacity is such as materially to reduce arcing on interruption.

The movable arcing circuit is arranged to take advantage of the electromagnetic forces developed on short circuits to insure that, on closing, the arcing contacts after once making contact remain closed with a strong pressure and on opening do not release until the main brushes have safely parted.

This type breaker is furnished for 600 and 1,200 amp. at 15 kv. and 600 amp. at 23 kv., with an estimated interruption capacity of 175,000 kva. at 15 kv. and 150,000 kva. at 23 kv.

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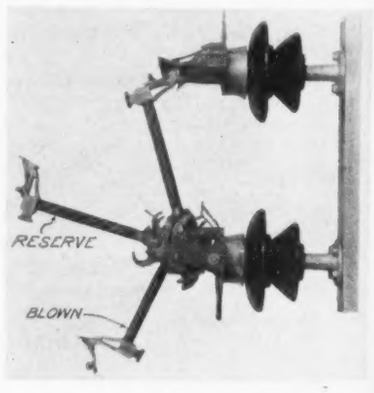
High-Voltage Automatic Re-fusing

A three-shot repeating fuse for high-voltage use has been announced by the Southern States Equipment Company, Birmingham, Ala. In this three expulsion-tube fuses are mounted side by side, one being in the circuit, while the two others are held in reserve. When



the circuit fuse blows the tube drops open and releases the next fuse, which automatically swings closed. A blown fuse is replaced and put back in the reserve position without interrupting service or disturbing the other tubes. The device is available for all voltages between 7.5 kv. and 110 kv.